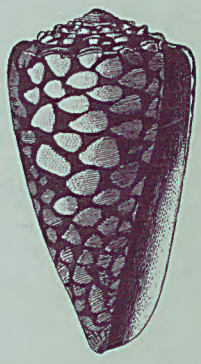
MUSEUM VICTORIA



Molluscan Research

Volume 19 (1)
19 May 1998

Published by
The Malacological Society of Australasia

Molluscan Research

(Formerly the Journal of the Malacological Society of Australia)

Molluscan Research is a publication for authoritative scientific papers dealing with the Phylum Mollusca and related topics. Two numbers are published in each annual volume. General and theoretical papers relating to molluscs are welcome. Papers concerning specific geographical areas or new taxa should normally focus on the Indo-West Pacific region, as well as Australasia and the Southern Ocean.

Published by:
The Malacological Society of Australasia Ltd
A.C.N. 067 894 848

ISSN 1323-5818

Copyright: © Council of the Malacological Society of Australasia

Cover Design: Jane Guy, Queen Victoria Museum, Launceston
Printed by: The North-Eastern Advertiser Pty. Ltd.
P.O. Box 195, SCOTTSDALE, Tasmania 7260.

Editor: Dr Brian J. SMITH, Queen Victoria Museum, Launceston, Tasmania

Editorial Board:

Dr A.G. Beu, Institute of Geophysical and Nuclear Sciences, Lower Hutt, New Zealand
Dr P. Bouchet, Musèum National d'Histoire Naturelle, Paris, France
Mr R. Burn, Museum of Victoria, Melbourne, Victoria
Dr T.A. Darragh, Museum of Victoria, Melbourne, Victoria
Dr L.M. Joll, W.A. Fisheries Department, Perth, Western Australia
Dr B.A. Marshall, National Museum of New Zealand, Wellington, New Zealand
Dr W.F. Ponder, Australian Museum, Sydney, New South Wales
Dr D. Reid, The Natural History Museum, London, United Kingdom
Dr G. Rosenberg, Academy of Natural Sciences, Philadelphia, Pennsylvania, U.S.A.
Dr W.B. Rudman, Australian Museum, Sydney, New South Wales
Dr J. Stanisic, Queensland Museum, Brisbane, Queensland
Prof. E.S. Upatham, Mahidol University, Bangkok, Thailand
Dr F.E. Wells, Western Australian Museum, Perth, Western Australia
Dr R.C. Willan, Museums and Art Galleries of the Northern Territory, Darwin, Northern Territory

MUSEUM VICTORIA
4 JUN 1998

MOLLUSCAN RESEARCH

Volume 19, Number 1 19 May 1998

CONTENTS

K. Lamprell & J. Stanisic
Myidae from Australian waters (Mollusca, Bivalvia) ... 1

H. H. Dijkstra
Pectinoidea (Mollusca: Bivalvia: Pectinidae: Propeamussiidae) from Hansa Bay, Papua New Guinea ... 11

B. A. Marshall
A new monoplacophoran (Mollusca) from southern New Zealand ... 53

B. Scott
Anatomy and relationships of the papuinine land snail *Meliobba shafferyi* Iredale, 1940 (Pulmonata: Stylommatophora: Camaenidae) ... 59

B. A. Marshall
Food and feeding mode of Thysanodontinae (Mollusca: Gastropoda: Calliostomatidae) ... 69

B. A. Marshall
A review of the Recent Trochini of New Zealand (Mollusca: Gastropoda: Trochidae) ... 73

B. A. Marshall
The New Zealand Recent species of *Cantharidus* Montfort, 1810 and *Micrelenchus* Finlay, 1926 (Mollusca: Gastropoda: Trochidae) ... 107

Short Communication
D. L. Geiger
Note on the identity of *Haliotis clathrata* Lichtenstein, 1794 (not Reeve, 1846) ... 157

Book Review
B. Wilson
Mollusca: The Southern Synthesis, Parts A & B ... 160

Change of Editorship

In the 18 years from 1980 to 1997, Dr Fred. E. Wells editored and published 19 issues of *Molluscan Research* and it's predecessor, the *Journal of the Malacological Society of Australia*, from Vol. 4 No. 4 to Vol. 18 No. 2. During his editorship, he introduced, modified and successfully presented changes in format and cover design. As editor, not only had he to cope with the whims and idiosyncrasies of authors and their manuscripts, he had also to operate within the budgetry constraints of a relatively small, largely amateur, society. In both areas he achieved great success. The new editor, Dr Brian J. Smith, has been handed an established and highly respected malacological publication, in a form that will be received well into the 21st centuary.

The Council and members of the Malacological Society of Australasia, and the wider malacological community within Australia and beyond are, and will remain, indebted to Fred Wells for all these years of devoted and careful work.

Robert Burn

(I would like to add my tribute and thanks to that of former editor Robert Burn to Fred for his long, distinguished service to the Society and to Australasian malacology. As Robert has said, I have been handed a well established and highly repected malacological journal. At the suggestion of the Council I will be making some minor format changes to this and forthcoming issues, but in general I will be following the well established pattern handed to me by Fred. Thanks Fred for all the work.

Brian Smith - Editor)

Molluscan Research **19(1):** 1-10 *(1998)*

Myidae from Australian waters (Mollusca, Bivalvia)

Kevin Lamprell and *John Stanisic*

Queensland Museum, PO Box 3300, South Brisbane, Queensland 4101

Abstract

Cryptomya (Venatomya) blackburnae sp.nov from mideastern Queensland, Northern Territory and north Western Australia is described and figured. *(V.) elliptica* (A.Adams, 1851) from New South Wales and Queensland is refigured and a detailed description given. *Tugonia (Distugonia) inopinata* (Iredale, 1936) from New South Wales and Queensland is briefly discussed. A lectotype is designated for *Sphaenia elliptica* A.Adams, 1851.

Key words: Myidae, Australia.

Introduction

The Myidae is a family of mainly infaunal burrowing bivalves with a long, single siphonal process. Myid species are characterised by a fragile, chalky shell with a moderate to wide posterior gape and a large projecting chondropore in the left valve. Most species live buried in sand or mud to depths of 20cm. Some burrow into soft rock. The group is relatively small with about 20 species worldwide (Boss 1982). Myids are comparatively well known in the Northern Hemisphere (Lamy 1927; Habe 1951; Laursen 1966; Bernard 1979; Backeljau 1982; Stökland 1985), particularly through the widespread introduction from North America to Europe in the 17th century, of the large commercially fished *Mya arenaria* (Linnaeus, 1758) (Foster 1946). The family is also well represented in the boreal fossil record (Keen 1969). Fewer Recent species appear to be have been documented from the Southern Hemisphere and only two have been hitherto described from Australia. No Recent or fossil myids are known from New Zealand, but Tertiary fossils have been found in Antarctica (Zinsmeister 1984; Stilwell & Zinsmeister 1992). In this context the discovery of a new species in waters of northern Australia is noteworthy. Examination of the extensive molluscan collection of the Australian Museum, Sydney confirmed that the Myidae is not well represented in Australian waters. However, given the low profile of the family in the literature and the cryptic habits and small size of some of the species, additional representatives may yet be described. In order to raise the perspective of this family in the contemporary literature the two previously described species are refigured. No live material has been examined; all the specimens used in the study were collected dead.

Previous Studies

The first record of the family in Australia was of *Sphaenia elliptica* described by A.Adams (1851) from Sydney, New South Wales. Subsequently placed in *Cryptomya* (see Angas 1871; Hedley 1913) this species was considered worthy of subgeneric recognition by Iredale (1930) who erected *Venatomya* to accommodate it. Keen (1969) recognised *Venatomya* as a valid subgenus, differing from *Cryptomya* s.s. by having a small, variably sized pallial sinus (pallial sinus absent in *Cryptomya* s.s.) and small anterior tooth in front of the chondropore in the right valve (absent in *Cryptomya* s.s.).

Eighty-five years after the description of this species, *Distugonia inopinata* Iredale, 1936 was described from Sydney Harbour dredgings. While similar to *Tugonia* Gray, 1842 and *Tugonella* Jousseaume, 1891, *Distugonia* differs in shape and in having weak, concentric growth lines and a small, attenuated rostrum. Keen (1969) considered that *Distugonia* was only subgenerically distinct from *Tugonia* s.s. differing in its more extended rostrum and concentric sculpture (radial or reticulate in *Tugonia* s.s.). *Tugonia* differs from *Cryptomya* in having an attenuated rostrum (wide in *Cryptomya*) and inflated body with umbones situated toward the posterior (*Cryptomya* not inflated and almost equilateral).

Materials and Methods

All specimens used in this study derive from the collections of the Australian Museum, Sydney (AMS), the Museum and Art Gallery of the Northern Territory, Darwin (NTM), The Natural History Museum, London (BMNH) and the Western Australian Museum, Perth (WAM). A search of the Queensland Museum, Brisbane did not reveal any additional specimens.

Shell measurements were made using vernier calipers according to the method outlined in Fig. 1.

Morphological abbreviations used: lv, left valve; rv, right valve; pv, paired valves.

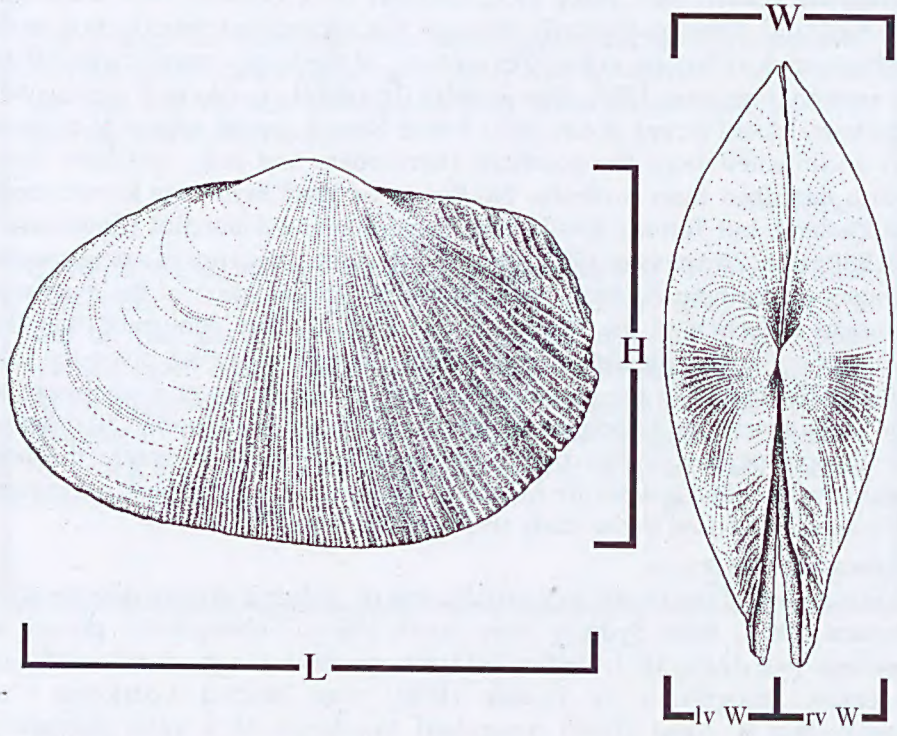


Figure 1. Shell measurements of *Cryptomya (Venatomya)* and *Tugonia (Distugonia)*. L = length, H = height, W = width of conjoined valves, lv W = left valve width, rv W = right valve width.

Systematics
The systematic arrangement follows Keen (1969).

Order **MYOIDA** Stoliczka, 1870
Suborder **MYINA** Stoliczka, 1870
Superfamily **MYOIDEA** Lamarck, 1809
Family **MYIDAE** Lamarck, 1809
Genus **Cryptomya** Conrad, 1848

Cryptomya Conrad, 1848: 121.
Type species: *Sphaenia californica* Conrad, 1837 - by monotypy. Recent, Indo-Pacific.

Diagnosis: Narrowly gaping; chondropore in lv large, with triangular anterior portion in front of anterior ridge as in *Mya*; rv with an inconspicuous, subumbonal chondropore; posterior gape and pallial sinus obscure.

Subgenus **Venatomya** Iredale, 1930

Venatomya Iredale,1930: 283.
Type species: *Sphaenia elliptica* A.Adams, 1851 - by original designation. Recent, Indo-Pacific.

Diagnosis: Small anterior cardinal tooth in front of chondropore in rv; pallial sinus variable in size.

Cryptomya (Venatomya) blackburnae sp.nov.
(Fig. 2a-e)

Etymology: For Lady Helen Blackburn who collected and presented the holotype to the Australian Museum.

Description: Shell to 48 mm in length; elongate-ovate, wider posteriorly; equivalve, approximately equilateral. Umbones moderately inflated, rising above dorsal margin. Lunule obscure, lanceolate, longitudinally striate. Escutcheon long. Antero-dorsal margin long, convex, rounded terminally at the antero-ventral margin; postero-dorsal margin almost straight, angulate at the posterior margin; posterior margin slightly convex, gaping; ventral margin widely convex posteriorly then almost straight and rising to anterior margin termination. Each valve of the shell with an ill-defined posterior fold extending from the umbo to the postero-ventral margin. Sculpture on anterior third of shell consisting of dense concentric growth striae; whole shell granulated, medially with numerous radial grooves extending from the umbo to the ventral margin, becoming more pronounced posteriorly, visible internally. Posterior fold with stronger concentric grooves to dorsal margin and devoid of any radial sculpture. Posterior half of shell with few concentric growth striae. Hinge of lv with shallow, spoon-shaped chondropore extending posteriorly. Hinge of rv with chondropore horizontally depressed under umbo and a small tooth situated

slightly in front of the chondropore. Colour white internally and externally. Pallial sinus wide, shallow, barely visible.

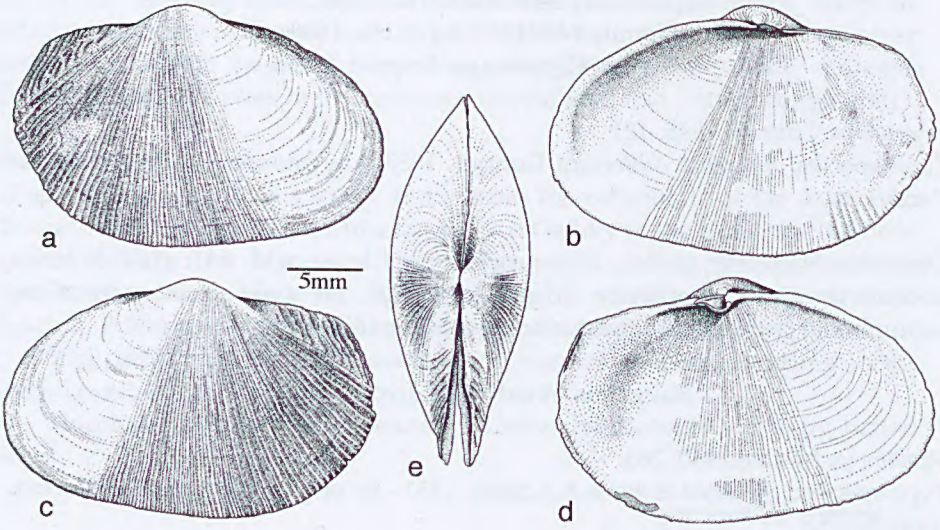


Figure 2. *Cryptomya (Venatomya) blackburnae* sp. nov. AMS C304578, Port Keats, Northern Territory, holotype. a,b, right valve; c,d, left valve; e, top view. Scale line as marked. [Drawings by A.Hill].

Material Examined

Holotype: 1 pv, AMS C304578, 14°05'-14°15'S, 129°35'E, Port Keats, Northern Territory, found on beach after rough weather. Length 24.7 mm, height 16.5mm, width of pv 9.7 mm.

Paratypes: Queensland: 1 lv, AMS C73227, 17°29'S, 140°50'E, Karumba, Gulf of Carpentaria. Northern Territory: 3 pv, 1 lv, 2 rv, NTM P3517; 12 rv, 5 lv, NTM P2801; 1 rv, NTM P4229; 1 pv, 1 rv, 2 lv, NTM P5152 - all 12°21'S, 130°53.3'E, Free Beach, adjacent to outlet of Sandy Creek, NE of Casuarina Beach, Darwin; 3 lv, NTM P4369, 12°19.5'S, 131°00.8'E, north of Howard River, western end of Gunn Beach, Shoal Bay E of Darwin; 2 lv, AMS C307049, 11°29'S, 132°02'E, Cape Bedwell, SW Cobourg Peninsula; 2 lv, AMS C307052, 14°00'S, 136°25'E, Groote Eylandt, Gulf of Carpentaria; 75 rv, 5 lv, AMS C307050, 12°00'S 134°27'E, Boucaut Bay, Arnhem Land; 1 rv, AMS C307051, 12°15'S, 136°53'E, Yirrkala, Gove Peninsula, Arnhem Land; 3 lv, 5 rv, WAM 108.96, Port Essington, intertidal in muddy sand, Aug 1986. Western Australia: 4 lv, 1 rv, WAM 109.96, Mitchell River Estuary, 20 km S of Pickering Point, Jul 1977.

Largest paratype : 1 lv, WAM 109.96, Mitchell River Estuary, 20 km S of Pickering Point, length 48.2 mm, height 28.7 mm, width of lv 9.5 mm.

Other material: Queensland: 1 lv, juvenile, AMS C307058, 23°49'S, 151°22'E,

Facing I., Port Curtis; 1 lv, AMS C307057, 23°17'S, 150°50'E, Zilzie Point, Yeppoon. Northern Territory: 1 lv, juvenile, AMS C307074, 9°18'S, 133°38'E, 230 km N of Goulburn I, dredged.

Habitat: Unknown. Shells examined were dead specimens, dredged or found on beach.

Distribution: Mideastern Queensland, Northern Territory and north Western Australia.

Remarks: Cryptomya (Venatomya) blackburnae sp.nov. can be distinguished from *C. (V). elliptica* (A.Adams) by the presence of strong concentric ridges in the posterior area. *C. (V). elliptica* is more elliptic in shape and lacks the attenuate anterior and wide posterior margin of *C. (V). blackburnae.*

Cryptomya (Venatomya) elliptica (A.Adams, 1851)
(Fig. 3a-d)

Description: Shell to 23.4 mm in length; elliptical, with an obscure posterior angle which extends from the umbo to the postero-ventral margin, moderately compressed; umbones low, rising only slightly above dorsal margin. Sculpture of strong radial grooves medially which are absent at the anterior third and on the posterior area. Colour white internally and externally.

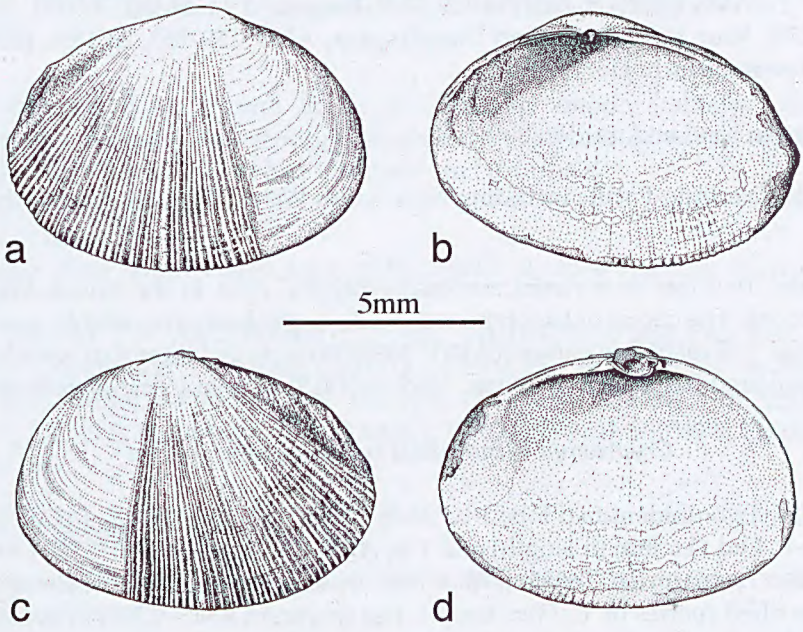


Figure 3. *Cryptomya (Venatomya) elliptica* (Adams, 1851). AMS C67994, Gunnamatta Bay, Port Hacking, New South Wales. a,b, right valve; c,d, left valve. Scale line as marked. [Drawings by A.Hill].

Material Examined
Lectotype (here designated): 1 pv, BMNH 1907.10.28.145, Sydney, H. Harvey collection, in the Hanley collection, labelled co-type. Length 14.3 mm, height 9.1 mm, width of pv 6.5 mm.
Paralectotypes: 1 pv, 2 lv, 1 rv, BMNH 1995226, Sydney, 7 m, mud, Mr Strange.
Other material: New South Wales: 1 pv, 3 lv, 2rv, AMS C67994, 34°04'S, 151°09'E, Gunnamatta Bay, Port Hacking; 1 pv, AMS C16971, 33°50-33°52'S, 151°12'-151°16'E, Port Jackson; 1 lv, AMS C307065, 33°33'S, 151°16'E, Patonga, Broken Bay; 1 lv, 33°48'S, 151°16'E, North Harbour, Sydney; 3 lv, 3rv, AMS C002434, 33°50'-33°50.6'S, 151°10.3'-151°10.7'E, Lane Cove River, Sydney, 5.5 m, black sandy mud; 2 lv, AMS C67993, 33°57'S,151°10'E, Cooks River, Tempe, Botany Bay; 6 rv, 9 lv, AMS C307064, 33°48.3'S, 151°14.4'E, The Spit, Middle Harbour, Sydney; series, AMS C307060, 33°51'S, 151°11'E, off Morts Dock, Balmain, Sydney; 1 pv, AMS C307053, 33°50'-33°50.6'S, 151°10.3'-151°10.7'E, Lane Cove River, Sydney; 1 lv, AMS C307055, 32°43'S, 152°15'E, off Nelsons Bay, Port Stephens; 1 lv, AMS C12716, 33°10'S, 151°39'E, Catherine Hill Bay. Queensland: 1 lv, 1 rv, AMS C307061, juveniles, 25°18'S, 152°46'E, Dundowran, Hervey Bay; 1 rv, AMS C29727, 16°54'S, 145°23'E, Weary Bay; 4 lv, 20°04'S, 148°22'E, Main Beach, Bowen; 3 rv, 3 lv, AMS C307063, 27°34'S, 153°20'E, Coochiemudlo I., Cleveland; 2 lv, AMS C307056, 25°17'S, 152°50'E, Pialba, Hervey Bay; 15 rv, 4 lv, AMS C10073, 18°40'S, 146°33'E, Palm I.; 8 rv, 10 lv, AMS C307066, 25°18'S, 152°46'E, Dundowran Beach, Hervey Bay; 19 rv, 8 lv, AMS C41625, 15°32'S, 145°17'E, off Annan River mouth; 1 rv, AMS C307059, 27°15'S, 153°15'E, Moreton Bay; 1 lv, AMS C307068, 24°49'S, 152°28'E, Bargara; 1 rv, AMS C307070, 16°33'S, 145°29'E, Four Mile Beach, Port Douglas; 1 lv, AMS C307067, 25°18'S, 152°46'E, Dundowran Beach, Hervey Bay.

Habitat: In sand and mud to 8 m.

Distribution: Indo-Pacific including New South Wales, Queensland and the Red Sea.

Remarks: Two lots of material marked "syntypes" exist in the British Museum collections. The choice of lectotype was made on the basis of available specimen material. The lot of five valves (BMNH 1995226) included three that were broken and unpaired left and right valves. Hedley (1913) figured material from this lot.

Cryptomya (Venatomya) possible new species

Remarks: Two unidentified lots, 1 lv, AMS C307071, from 10°38'S, 142°35'E, E of Banks I., Qld (4.6 mm in length) and 1 lv, AMS C307072, from 11°37'S, 130°23'E, Bathurst I., Northern Territory (6.5 mm in length), appear to belong to an undescribed species of *C. (Venatomya)*. The specimen AMS C307071 is elongate with the umbo situated anteriorly, posterior attenuate and gaping at its termination. Sculpture consists of concentric ridges without any radial ridges as in the *C. (V.) blackburnae* sp. nov. The specimen AMS C307072 is similar to AMS C307071 but differs in having an internal fold extending obliquely from the

medial section of the shell posteriorly to the ventral margin. Its concentric sculpture consists of strong growth ridges with finer intervening ridges. Insufficient material currently exists to accurately determine the status of these specimens.

Genus **Tugonia** Gray, 1842

Tugonia Gray, 1842: .
Type Species: *Mya anatina* Gmelin, 1791.

Diagnosis: Inflated, equivalve, inequilateral, beaks situated posteriorly; rostrum short, truncate, widely gaping, set off by a constriction; sculpture of radial or reticulate striae, stronger medially with concentric growth lines.

Subgenus **Tugonia (Distugonia)** Iredale, 1936

Distugonia Iredale, 1936: .
Type Species: *Distugonia inopinata* Iredale, 1936 - by original designation. Recent, Australia-East Asia.

Diagnosis: Posterior area moderately attenuated; sculpture of concentric growth lines only.

Tugonia (Distugonia) inopinata (Iredale, 1936)
(Fig. 4a-b)

Description: Shell to 21 mm in length; inflated; anterior widely rounded; compressed ventrally and tapering posteriorly. Sculpture of strong concentric growth lines. Colour lime-white internally and externally.

Material examined
Holotype: New South Wales: 1 pv, AMS C60626, Sydney Harbour, New South Wales.
Other Material: 1 lv, AMS C304577, 33°50'S, 151°16'E, Sow and Pigs Reef, Port Jackson. Queensland: 1 pv, AMS C304574, 24°55'S, 152°29'E, Elliot River estuary; 1 rv, 1 lv, AMS C304575, 24°55'S, 152°29'E, Elliot Heads; 1 lv, AMS C304576, 25°15'S, 152°49'E, Point Vernon; 1 lv, AMS C307075, 23°15'S, 150°49'E, Emu Park, Keppel Bay.

Habitat: In littoral sand.

Distribution: Central-eastern New South Wales to central east coast of Queensland.

Remarks: The unusual shape of *D. inopinata* readily distinguishes it from the preceding species. The greatly swollen posterior and laterally compressed anterior ends contrast with the more regularly globose shells of *Cryptomya (Venatomya)* spp.

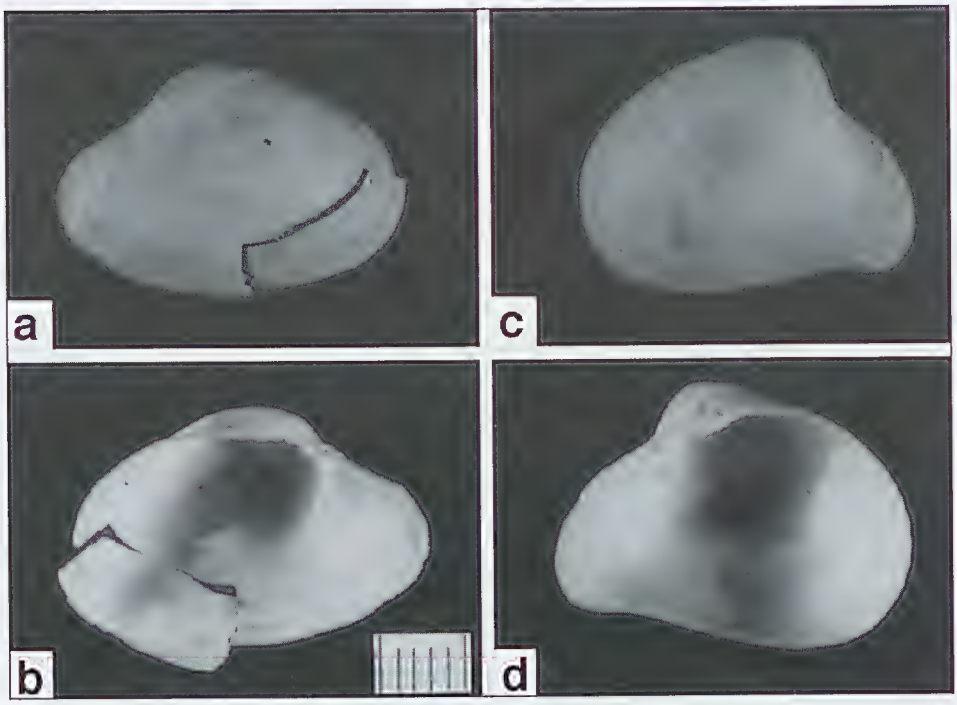


Figure 4. *Tugonia (Distugonia) inopinata* (Iredale, 1936). AMS C60626, Sydney Harbour, New South Wales, holotype. a,b, right valve; c,d, left valve. Scale lines = 1 mm.

Acknowledgements

For the supply of specimens and relevant data we would like to thank W. F. Ponder and I. Loch (AMS), K. Way (BMNH), R. Willan (NTM), W. Zeidler (SAM) and S. Slack-Smith (WAM). We are also indebted to the Australian Biological Resources Study, Canberra for permission to use the drawings which were prepared by Ms Alison Hill. Photographs of the type of *Distugonia inopinata* were prepared with the help of the Photography Section, Queensland Museum, Brisbane.

References

Adams, A. 1851. Monograph of *Sphaenia*, a genus of lamellibranchiate Mollusca. *Proceedings of the Zoological Society of London*, **1850:** 86-89.

Angas, G.F. 1871. A list of additional species of marine Mollusca to be included in the fauna of Port Jackson and the adjacent coasts of New South Wales. *Proceedings of the Zoological Society of London*, **1871:** 87-101.

Backeljau, T. 1982. The genus *Mya* in Europe. *Gloria Maris* **21(5):** 105-221.

Bernard, F.R. 1979. Identification of the living *Mya* (Bivalvia: Myoida). *Venus* **38(3):** 185-204.

Boss, K.J. 1982. Mollusca, in *'Synopsis and classification of living organisms'*. Parker, S.P. (ed.), (McGraw-Hill, New York), pp. 945-1166.

Foster, R.W. 1946. The genus *Mya* in the western Atlantic. *Johnsonia* **3:** 29-35.

Habe, T. 1951. Donacidae and Myidae in Japan, in *'Illustrated catalogue of Japanese shells'*. Kuroda, T. (ed.), (Kyoto, Japan), pp. 71-78.

Hedley, C. 1913. Studies on Australian Mollusca, 9. *Proceedings of the Linnaean Society of New South Wales* **38:** 258-339.

Iredale, T. 1930. More notes on the marine Mollusca of New South Wales. *Records of the Australian Museum* **17:** 384-407.

Iredale, T. 1936. Australian Molluscan Notes No.2. *Records of the Australian Museum* **19(5):** 267-340.

Keen, M. 1969. The Myidae. in: *'Treatise on invertebrate paleontology'*, Part N, Vol. 2 (of 3), pp. N691-692. Mollusca 6, Bivalvia. R.C. Moore (ed.), (Geological Society of America and University of Kansas Press: Lawrence).

Lamy, E. 1927. Revision des Myidae vivants du Museum National d' Histoire Naturelle de Paris. *Journal de Conchyliologie* **70:** 151-185.

Laursen, D. 1966. The genus *Mya* in the Arctic region. *Malacologia* **3(3):** 399-418.

Stilwell, J.D. & Zinsmeister, W.J. 1992. Molluscan Systematics and Biostratigraphy. Lower Tertiary La Meseta Formation, Seymour Island, Antarctic Peninsula. *Antarctic Research Series* **55:** 1-192.

Stökland, O. 1985. The bivalve genus *Mya* in Norwegian waters. *Fauna Oslo* **38(3):** 83-86.

Zinsmeister, W.J. 1984. Late Eocene bivalves (Mollusca) from the La Meseta Formation collected during the 1974-75 Joint Argentina-American Expedition to Seymour Island, Antarctic Peninsula. *Journal of Palaeontology* **58(6):** 1497-1527.

Molluscan Research **19(1):** 11-52 *(1998)*

Pectinoidea (Mollusca: Bivalvia: Pectinidae: Propeamussiidae) from Hansa Bay, Papua New Guinea

(King Leopold III Biological Station, Laing Island, Papua New Guinea - Contribution No. 337.)

Henk H. Dijkstra

Institute of Systematics and Population Biology, University of Amsterdam,
Zoological Museum, Department of Malacology, P.O. Box 94766,
1090 GT Amsterdam, The Netherlands.

Abstract

Thirty five species of Pectinoidea (33 Pectinidae, 2 Propeamussiidae) are described from Hansa Bay, Papua New Guinea. *Serratovola pallula* n. sp. is here introduced as new to science. Lectotypes are designated of *Pecten cloacatus* Reeve, 1853 and *Pecten tricarinatus* Anton, 1838, and type localities are designated for *Pecten vexillum* Reeve, 1853, *Pecten spectabilis* Reeve, 1853, and *Ostrea squamosa* Gmelin, 1791.

Key words: Pectinoidea, Propeamussiidae, Pectinidae, Hansa Bay, Papua New Guinea.

Introduction

During 1976 to 1983 several Belgian expeditions were undertaken to Hansa Bay, Papua New Guinea, viz. PNG 1976 (IG 25.485), PNG 1977 (IG 25.681, 25.715, 25.930), PNG 1978 (IG 25.848, 25.955), PNG 1979 (IG 26.080, 26.086, 26.132), PNG 1980 (IG 26.227, 26.253), PNG 1981 (IG 26.373) and PNG 1983 (IG 26.700). Hansa Bay is part of the Bismarck Sea and situated between Madang and Sarang (4°10'S 144°52'E) and is about 8 km long. Several rivers carry a large amount of sediment to Hansa Bay and near the shore the bottom is muddy, further off shore more sandy with coral rubble. In the central part of the bay coral reefs (Duangit reefs) and an island (Laing Island), surrounded by coral reefs, are exposed. Sea temperature and salinity average 29.4°C and 33.4% respectively (Bouillon, et al. 1986). The difference in tide level is about 1.30 m (Claereboudt and Bouillon 1987).

Thirty five species of Pectinoidea were collected, including twenty six alive, on exposed reefs, by scuba-diving and by dredging or trawling to 125 m. One pectinid species is new to science. Three type localities are designated herein.

The material is deposited in the molluscan collection of the Koninklijk Belgisch Instituut voor Wetenschappen (KBIN) and additional material in the reference collection of the author (ex Tursch collection).

Taxonomy and conchological terms are according to Waller (1972, 1978, 1984, 1986, 1991, 1993).

Abbreviations and text conventions

AMS, Australian Museum, Sydney
BMNH, Natural History Museum, London
HD, Henk H. Dijkstra collection, Sneek
IG, Inventaire général (indication to KBIN collection material)
KBIN, Koninklijk Belgisch Instituut voor Wetenschappen, Brussels

LSL, Linnaean Society, London;
MHNG, Muséum d'Histoire Naturelle, Geneva
MNHN, Muséum National d'Histoire Naturelle, Paris
NHMW, Naturhistorisches Museum Wien, Vienna
NNM, Nationaal Natuurhistorisch Museum (formerly RMNH), Leiden
PC, Phil Crandall collection, Okinawa
PNG, Papua New Guinea
QM, Queensland Museum, Brisbane
SMTD, Staatliches Museum für Tierkunde, Dresden
TMMT, Taiwan Museum, Taipei
UMZC, University Museum of Zoology, Cambridge (U.K.)
USNM, National Museum of Natural History, Washington D.C.
UUZM, Uppsala University Zoological Museum, Uppsala
WAM, Western Australian Museum, Perth
ZMA, Zoölogisch Museum, Amsterdam
ZMUC, Zoologisk Museum, Copenhagen
ZSI, Zoological Survey of India, Calcutta

Systematics

Superfamily **PECTINOIDEA** Wilkes, 1810 [emend., Waller, 1978]
Family **PROPEAMUSSIIDAE** Abbott, 1954
Genus **Parvamussium** Sacco, 1897

Parvamussium Sacco, 1897a: 102; 1897b: 48 (diagnosis).
Type species (by original designation): *Pecten (Pleuronectes) duodecimlamellatus* Bronn, 1832; Upper Miocene, northern Italy.

Parvamussium pauciliratum (E.A. Smith, 1903)
(Plate 1, figs. 1-2)

Amussium paucilirata [sic] E.A. Smith, 1903: 622, pl. 36, figs. 23-24.
Parvamussium pauciliratum (Smith). Dijkstra, 1995b: 26, figs. 107-110, 151-152 [references, description, discussion].

Type material: Lectotype BMNH 1903.9.17.17, designated by Dijkstra (1995b: 28).

Type locality: S Nilandu Atoll, Maldive Islands, 2-66 m.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1976: 206, Laing Island, dredged, 30 m, leg. J. Pierret, 29.III.1976, 3 valves, IG 25.485; PNG 1976: NW Duangit, trawled, 60-65 m, leg. B. Tursch and J. Pierret, 1976, 1 live specimen, IG 26.132; PNG 1979: 419, Duangit reef, E-side, fine coral sand, diving, hand-dredged, 48 m, leg. J. Pierret, 23.VI.1979, 7 live specimens, IG 26.080; PNG 1980: 12, SE Duangit, dredged, 50-52 m, leg. J. Pierret, 29.IX.1980, 1 valve, IG 26.227; PNG 1980: 40, E Duangit, dredged, 50 m, leg. J. Pierret, 22.IX.1980, 1 valve, IG 26.253; PNG 1980: 77, SE Duangit, dredged, 50 m, leg. J. Pierret, 21.XI.1980, 3 valves, IG 26.227; PNG 1981: 181, Wanginem reef, hand-dredged, 43 m, leg. J. Pierret, 28.V.1981, 1 valve, IG 26.373; PNG 1981: 392, muddy sand, hand-dredged, 57 m, leg. J. Pierret, 28.VI.1981, 1 specimen, IG 26.373; off Awar, trawled, 100-125 m, 3 live specimens, ex Tursch coll. (HD).

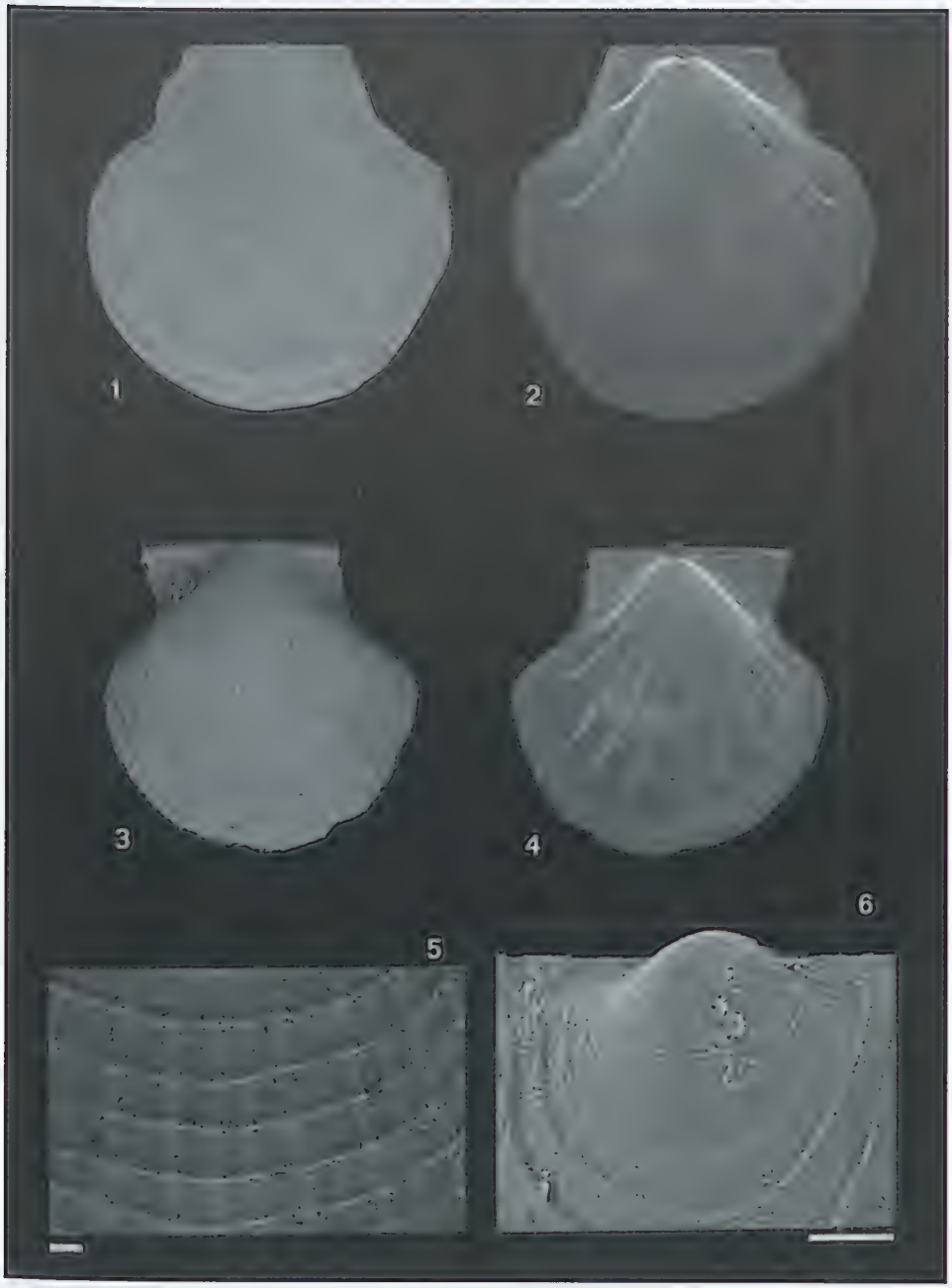


Plate 1.
Figures 1-2. *Parvamussium pauciliratum* (E.A. Smith, 1903). HD, off Awar, 100-125 m, H 8.1 mm, db. 1. Left valve, exterior. 2. Left valve, interior. **3-6.** *Parvamussium scitulum* (E.A. Smith, 1885). HD, off Awar, 75 m, H 6.9 mm, db. 3. Left valve, exterior. 4. Left valve, interior. 5. Left valve, exterior, central section (scale bar 100 μm). 6. Left valve, exterior, prodissoconch + preradial section (scale bar 100 μm).

Distribution: Northern Indian Ocean, Indonesia to New Caledonia. Living on muddy, muddy sand or sandy bottoms amongst coral rubble at littoral to bathyal depths.

Parvamussium scitulum (E.A. Smith, 1885)
(Plate 1, figs. 3-6)

Amussium scitulum E.A. Smith, 1885: 312, pl. 23, figs. 4-4b.
Parvamussium scitulum (Smith). Dijkstra, 1995b: 31, figs. 43-46, 153-154 [synonymy, references, description, discussion].

Type material: Lectotype BMNH 1887.2.9.3319/1, designated by Dijkstra (1995b: 31).

Type locality: "Challenger" stn. 188, 9°59'S 139°42'E, S of New Guinea, 51 m.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1980: 78, NE Laing Island, dredged, 48-50 m, leg. J. Pierret, 23.XI.1980, 1 valve, IG 26.227; PNG 1980: 80, Hansa Bay, SE Duangit, dredged, 50-52 m, leg. J. Pierret, 29.XI.1980, 1 valve; off Duangit reef, dredged, 60-80 m, 3 live specimens, ex Tursch coll. (HD); off Awar strip, dredged, 75 m, 4 live specimens, ex Tursch coll. (HD); off Awar strip, dredged, 100-125 m, 1 live specimen, ex Tursch coll. (HD); Laing Island, 7 live specimens, ex Tursch coll. (HD).

Distribution: Western and southwestern Pacific, from Japan to New Caledonia. Living on muddy or muddy sand sediments with coral rubble at littoral to bathyal depths.

Family **PECTINIDAE** Wilkes, 1810 [emend. Waller, 1978]
Subfamily **PECTININAE** Wilkes, 1810
Tribe **DECATOPECTININI** Waller, 1986
Genus **Anguipecten** Dall, Bartsch & Rehder, 1938

Anguipecten Dall, Bartsch & Rehder, 1938: 92.
Type species (by original designation): *Anguipecten gregoryi* Dall, Bartsch & Rehder, 1938 [= *Pecten lamberti* Souverbie in Montrouzier & Souverbie, 1874]. Miocene-Recent, Indo-West Pacific (Hayami, 1989: 15).

Anguipecten picturatus Dijkstra 1995
(Plate 2, fig. 1)

Pecten aurantiacus A. Adams & Reeve, 1850: 74, pl. 21, f. 12.
Anguipecten picturatus Dijkstra, 1995a: 15 (new name for *P. aurantiacus* Adams & Reeve, not Röding, 1798, not J. Sowerby, 1820, not Defrance, 1825). Dijkstra & Kastoro, 1997: 279 [synonymy, references].

Type material: Holotype BMNH 1950.11.14.8.
Type locality: "China Sea" [South China Sea].

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1977, Laing Biological Station, Duangit reef, 45 m, leg. B. Tursch and J. Pierret, 1 valve, IG 25.930; PNG 1981: 77, SE of Laing Island, dredged, 45 m, leg. J. Pierret, 21.XI.1980, 4 valves, IG 26.227; Laing Island, 40 m, 1 specimen, ex Tursch coll. (HD).

Distribution: Western Indian Ocean and Indo-West Pacific. Living amongst coral rubble on sand or muddy sediments at littoral to sublittoral depths.

Remarks: The present specimens are similar to the type material, although the auricles are slightly smaller and the concentric lamellae on the right valve somewhat more prominent and the shell is more brightly coloured with orange and creamy spots.

This species is often confused in the literature with *A. lamberti,* which is only known from the Hawaiian Islands and New Caledonia.

Anguipecten superbus (G. B. Sowerby 2nd, 1842)
(Plate 2, figs. 2-3)

Pecten superbus G. B. Sowerby 2nd, 1842: 62, pl. 12, f. 11.
Anguipecten superbus (Sowerby). Habe, 1981: 69, pl. 1, f. 3. Abbott & Dance, 1982: 312, fig. Dijkstra, 1984: 8, fig. Springsteen & Leobrera, 1986: [text unpag.], pl. 93, f. 8.

Type material: Two syntypes BMNH 1950.11.14.78-79.

Type locality: Not mentioned in original description, although "Amboina" [= Ambon, Indonesia] on labels of type lot.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1980: Laing Island, leg. J. Pierret, v. 1980, 3 valves, IG 26.253; Laing Island, 1 specimen, ex Tursch coll. (HD).

Distribution: Western Indian Ocean, and western and southwestern Pacific. Living on sand amongst coral rubble in the littoral.

Remarks: The present specimens are similar to the type material, but the radial costae vary in number (21 to 25); otherwise no different shell features.

Genus **Bractechlamys** Iredale, 1939

Bractechlamys Iredale, 1939: 366.
Type species (by original designation): *Bractechlamys evecta* Iredale, 1939 [=*Pecten vexillum* Reeve, 1853], tropical Indo-West Pacific and western Atlantic.

Bractechlamys oweni (De Gregorio, 1884)

Pecten pictus G. B. Sowerby 2nd, 1842: 62, pl. 20, f. 233.
Pecten (Chlamys) oweni De Gregorio, 1884: 133 (new name for *P. pictus* Sowerby, 1842; not Da Costa, 1778; not Röding, 1798; not Deshayes in Laborde, 1830; not Goldfuss, 1833).
Chlamys (Aequipecten) sp. cf. "*picta* (Sowerby)". Kuroda, 1932: 95, f. 108.
Cryptopecten oweni (De Gregorio). Habe, 1951: 77; 1977: 84; 1981: 67, pl. 5, f. 2. Bernard, Cai and Morton, 1993: 50.
Semipallium oweni (De Gregorio). Dijkstra, 1990: 8, 10.

Type material: Holotype BMNH 1950.11.14.53.

Type locality: Isle of Baicus, Philippines.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1976: 206, W of Laing Island, dredged, 30 m, leg. J. Pierret, 29.iii.1976, 1 valve, IG 25.485; PNG 1979: 31, Mililat (N of Madang), barrier reef, sand, coral rubble, hand-dredged, 12-25 m, leg. J. Pierret, 17.ii.1979, 1 live specimen, IG 26.080; PNG 1979: 47, Nagada (N of Madang), Wongat reef, sand, coral, dredged, 25 m, leg. J. Pierret, 30.x.1979, 1 live specimen, IG 26.086; PNG 1979: 49, Mililat (N of Madang), large reef at E side of Wongat, coral, 3-5 m, leg. J. Pierret, iii.1979, 1 live specimen, IG 26.080; PNG 1979: 54, Nagada (N of Madang), Wongat reef, sand, coral, algae, dredged, 25 m, leg. J. Pierret, 5.xi.1979, 1 live specimen, IG 26.086; PNG 1980: 2, Nagada (N of Madang), Rash reef, dredged, 25 m, leg. J. Pierret, 29.viii.1979, 1 valve, IG 26.086; PNG 1980: 18, Nagada (N of Madang), Wongat reef, dredged, 25-30 m, leg. J. Pierret, 6.ix.1979, 2 valves, IG 26.086; PNG 1980: 41, Nagada (N of Madang), Wongat reef, dredged, 25 m, leg. J. Pierret, 24.ix.1979, 1 valve, IG 26.086; PNG 1981: 59, Wanginem 2, dredged, 40 m, leg. J. Pierret, 22.x.1980, 1 valve, IG 26.253.

Distribution: Southern Japan, Philippines, Indonesia, Papua New Guinea to the Solomon Islands. Living amongst coral rubble on sand in the littoral.

Remarks: The present specimens are similar to the type material, although the coloration of the shell is somewhat paler. The radial costae are slightly more prominent than on the type specimen, and vary in number (12 to 14).

De Gregorio (1884) renamed *Pecten pictus* (preocc. Goldfuss, 1833), but overlooked *Pecten pictus* Deshayes in Laborde, 1830, which is a junior synonym of *Gloripallium maculosum* (Forsskål, 1775).

Bractechlamys vexillum (Reeve, 1853)
(Plate 2, fig. 4)

Pecten digitatus Hinds, 1845: 61, pl. 27, f. 2.
Pecten vexillum Reeve, 1853: text unpag., pl. 27, f. 114a-b.
Pecten distans Lamarck, 1819. G. B. Sowerby 2nd, 1842: 61, pl. 13, f. 46; pl. 18, f.

182 (not Lamarck). Reeve, 1853: text unpag., pl. 13, f. 49 (not Lamarck).
Pecten janus Montrouzier in Fischer, 1858: 340 (not Münster in Goldfuss, 1833).
Pecten (Chlamys) zeteki Hertlein, 1935: 306, pl. 19, f. 9 (new name for *Pecten digitatus* Hinds, 1845; not *P. digitatum* Perry, 1811).
Bractechlamys evecta Iredale, 1939: 367, pl. 5, f. 20-20a.
Semipallium zeteki (Hertlein). Grau, 1959: 122, pl. 41, f. 1-2.
Comptopallium vexillum (Reeve). Waller, 1972: 243, pl. 4, f. 64-75, pl. 5, f. 76-83, 86. Dijkstra, 1985: 7, figs.

Type material: Lectotype BMNH 197010, designated by Waller (1972: 243).

Type locality: Not mentioned in original description, although on labels of type lot "Australian Seas". Material from New Caledonia (MNHN), however, is very similar to the type specimens. A new type locality: Ilot Maître, Nouméa, New Caledonia, sandy bottom with seaweed, 20 m (MNHN) of *P. vexillum* is here introduced.

Material examined: The type material. PAPUA NEW GUINEA: PNG 1980: Hansa Bay, Mililat (N of Madang), small reef N, sandy slope and coral debris, hand-dredged, 12-15 m, leg. J. Pierret, 5.iii.1979, IG 26.080, 1 valve.

Distribution: Throughout the western and southwestern Pacific, from the Philippines, Indonesia, Papua New Guinea to New Caledonia. Living amongst seaweeds and coral rubble on muddy or sandy sediments in the littoral.

Remarks: The present specimen is similar to the type material, although more triangular than suborbicular of shape, but intermediate variations are also observed (MNHN).

Genus **Decatopecten** [Rüppell] G. B. Sowerby 2nd, 1839

Decatopecten [Rüppell] G. B. Sowerby 2nd, 1839: 37, 78, 121, f. 172.
Type species (by original designation): *Ostrea plica* Linnaeus, 1758. Miocene-Recent, Indo-West Pacific (Hayami, 1989: 15).

Decatopecten radula (Linnaeus, 1758)

Ostrea radula Linnaeus, 1758: 698.
Pecten argenteus Reeve, 1853: sp. 168 [text unpag.], pl. 35, f. 168.
Comptopallium pauciplicatum Iredale, 1939: 359.
Comptopallium radula (Linnaeus). Dijkstra: 1991: 43 [references, discussion].

Type material: Syntypes LSL and UUZM, not registered [Will be discussed in a forthcoming paper].

Type locality: "O. Indico" [= southwestern Pacific].

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1983: 105, Laing Island, lagoon, 2 m, leg. C. Massin, 16.x.1983, 1 live specimen, IG 26.700; Laing Island, dredged, 30 m, 1 specimen, ex Tursch coll. (HD); Laing Island, 1 specimen, ex Tursch coll. (HD); Koil Island, 1 specimen, ex Tursch coll. (HD).

Distribution: Throughout the Indo-West Pacific. Living amongst seaweeds, under stones or dead corals on muddy or sandy sediments in the littoral.

Remarks: The present specimens are similar to the type material. Observed material (AMS, BMNH, KBIN, MNHN, NNM, WAM, ZMA, ZMUC) are variable in radial costae (9 to 14).

Webb (1957: 53) described a new form of *D. radula* from northwestern Australia (with strongly, closely concentrically arranged, lamellae on the radial ribs), which could be an ecomorph (under study).

Dautzenberg & Bavay (1912: 25) considered *Pecten argenteus* Reeve, 1853 a synonym of *D. radula*. Dijkstra (1991: 44) synonymized it with *B. vexillum*. Recent juvenile material of *D. radula* from the Philippines (HD) is more similar to the type material of *P. argenteus*.

Genus **Excellichlamys** Iredale, 1939

Excellichlamys Iredale, 1939: 366.
Type species (by original designation): *Pecten spectabilis* Reeve, 1853. Miocene-Recent. Indo-West Pacific (Hayami, 1989: 15).

Excellichlamys spectabilis (Reeve, 1853)

Pecten spectabilis Reeve, 1853: text unpag., pl. 29, f. 128.
Pecten histrionicus Gmelin var. Petit de la Saussaye, 1853: 150, pl. 5, f. 2 (not *Ostrea histrionica* Gmelin, 1791).
Pecten (Aequipecten) histrionicus var. *spectabilis* Reeve. Dautzenberg & Bavay, 1912: 22.
Chlamys (histrionica var.?) *spectabilis* (Reeve). Kuroda, 1932: 95.
Aequipecten histrionicus var. *spectabilis* (Reeve). Lamy, 1935: 314.
Excellichlamys spectabilis (Reeve). Iredale, 1939: 366. Kuroda, Habe & Oyama, 1971: 366, pl. 79, f. 12-13. Waller, 1972: 246, pl. 5, f. 87-92, pl. 6, f. 93-102. Habe, 1981: 68. Abbott & Dance, 1982: 308, fig. Dijkstra, 1987: 9, figs.

Type material: Holotype UMZC 1461.

Type locality: Unknown. Here designated as Mauritius, according to similar material in BMNH. S. Morris (Darwin Museum, Downe, UK) suggests, after comparing three specimens of *E. spectabilis* from the general collection of the BMNH and the holotype of *E. spectabilis* (UMZC 1461), on an accompanying label: "They are obviously the same species. The smallest has virtually the same colour marks. These are not types but could have come from the same lot as the Saul Coll. 'Holotype'."

Plate 2.

Figure 1. *Anguipecten picturatus* Dijkstra, 1995. KBIN, SE Laing Island, 45 m, H 19.2 mm, rv, exterior. **2-3.** *Anguipecten superbus* (Sowerby, 1842). KBIN, Laing Island, H 32.9 mm, rv. 2. Right valve, exterior. 3. Right valve, interior. **4.** *Bractechlamys vexillum* (Reeve, 1853). KBIN, Mililat, 12-15 m, H 28.0 mm, lv, exterior. **5-6.** *Glorichlamys elegantissima* (Deshayes, 1863). KBIN, NE Laing Island, 30-35 m, H 13.9 mm, lv. 5. Left valve, exterior. 6. Left valve, exterior, ventral marginal section (scale bar 1 mm).

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1976: 206, W Laing Island, dredged, 30 m, leg. J. Pierret, 29.iii.1976, 1 valve, IG 25.485; PNG 1976: 222, Laing reef, dredged, 20 m, leg. A. Capart, 2.iv.1976, 1 valve, IG 25.485; PNG 1979: 18, Nagada (N of Madang), Wongat reef, dredged, 25-30 m, leg. J. Pierret, 6.ix.1979, 4 valves, IG 26.086; PNG 1979: 40, Gosem reef, dredged, 25-30 m, leg. J. Pierret, 23.ix.1979, 1 valve, IG 26.086; PNG 1979: 57, Wongat reef, sponges, muddy sand, dredged, 30 m, leg. J. Pierret, 7.xi.1979, 1 live specimen, IG 26.086; PNG 1980: 2, Nagada (N of Madang), Rash reef, dredged, 25 m, leg. J. Pierret, 29.viii.1980, 2 valves, IG 26.086; PNG 1980: 8, Nagada (N of Madang), Tab reef, dredged, 30 m, leg. J. Pierret, i.ix.1980, 1 valve, IG 26.086; PNG 1980: 11, Nagada (N of Madang), Wongat reef, dredged, 30 m, leg. J. Pierret, 2.ix.1980, 1 valve, IG 26.086; PNG 1980: 26, Nagada (N of Madang), Large Riu reef, dredged, 25 m, leg. J. Pierret, 14.ix.1980, 1 valve, IG 26.086; PNG 1980: 28, Laing Island I1, dredged, 28 m, leg. J. Pierret, 9.ix.1980, 1 valve, IG 26.253; PNG 1980: 30, Nagada (N of Madang), Gosem Island, dredged, 20 m, leg. J. Pierret, 17.ix.1980, 1 valve, IG 26.086; PNG 1980: 36, SE Duangit, dredged, 52 m, leg. J. Pierret, 17.ix.1980, 2 valves, IG 26.253; PNG 1980: 41, Nagada (N of Madang), Wongat reef, dredged, 25 m, leg. J. Pierret, 24.ix.1980, 1 valve, IG 26.086; PNG 1980: 43, S Duangit, E-side, dredged, 45-50 m, leg. J. Pierret, 25.ix.1980, 2 valves, IG 26.253; PNG 1980: 46, Laing Island, E1, dredged, 25-30 m, leg. J. Pierret, 3.x.1980, 1 valve, IG 26.253; PNG 1980: 59, Wanginem 2, dredged, 40 m, leg. J. Pierret, 22.x.1980, 1 valve, IG 26.253; PNG 1980: 67, Nagada (N of Madang), N Wongat reef, dredged, 25 m, leg. J. Pierret, 13.xi.1979, 1 valve, IG 26.086; PNG 1980: 69, Purar reef, under coral, 10 m, leg. J. Pierret, 29.x.1980, 1 valve, IG 26.253; PNG 1980: 236, Laing Island, W-side, hand-dredged, 17 m, leg. D. Christensen, 4.vi.1979, 1 valve, IG 26.080; PNG 1980: 258, Laing Island, W-side, diving, hand-dredged, 18-20 m, leg. D. Christensen, 6.vi.1979, 1 valve, IG 26.080; PNG 1980: 348, Duangit reef, hand-dredged, 10-15 m, leg. D. Christensen, vi.1980, 1 valve, IG 26.080; PNG 1981: 43, S Duangit, E-side, dredged, 45-50 m, leg. J. Pierret, 25.ix.1981, 1 valve, IG 26.253.

Distribution: Throughout the Indo-Pacific. Living amongst coral rubble on muddy or sandy sediments at littoral to sublittoral depths.

Remarks: The present specimens are similar to the type material, although the auricles are somewhat more unequal and the radial costae of the type specimen more prominent without small groves near the ventral margin. Intermediate variations, however, are also observed (HD, MNHN, NNM, ZMA).

Genus **Glorichlamys** Dijkstra, 1991

Glorichlamys Dijkstra, 1991: 45.
Type species (by original designation): *Pecten elegantissimus* Deshayes, 1863. Recent. Indo-West Pacific.

Glorichlamys elegantissima (Deshayes, 1863)
(Plate 2, figs. 5-6)

Pecten elegantissimus Deshayes, 1863: 32, pl. 4, f. 11-12.
Glorichlamys elegantissima (Deshayes). Dijkstra, 1991: 45, f. 91 [synonymy, references, discussion].

Type material: Depository unknown.

Type locality: Réunion.

Material examined: HANSA BAY, PAPUA NEW GUINEA: PNG 1980: 58, NE-end of Laing Island, hand-dredged, 30-35 m, leg. J. Pierret, 1980, 1 valve, IG 26.080.

Distribution: Throughout the Indo-Pacific. Living amongst coral rubble or in sandy sediments at littoral to sublittoral depths.

Genus **Gloripallium** Iredale, 1939

Gloripallium Iredale, 1939: 357.
Type species (by original designation): *Ostrea pallium* Linnaeus, 1758. Miocene-Recent. Indo-West Pacific (Hayami, 1989: 15).

Gloripallium pallium pallium (Linnaeus, 1758)

Ostrea pallium Linnaeus, 1758: 697.
Gloripallium pallium pallium (Linnaeus). Dijkstra, 1991: 46 [synonymy, references, discussion].

Type material: Syntypes LSL, not registered [Will be discussed in a forthcoming paper].

Type locality: "O. australiore and Indico" [Southwestern Pacific].

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1977, Laing Island, Duangit reef, dredged, 45 m, leg. J. Bouillon et al., 1977, 1 valve, IG 25.930; PNG 1980: C1, Laing Island, Duangit reef, dredged, 30 m, leg. J. Pierret, 29.v.1980, 1 valve, IG 26.253; PNG 1980: 5, Nagada (N of Madang), Tab Island, dredged, 10 m, leg. J. Pierret, 30.viii.1980, 1 valve, IG 26.086; PNG 1980: 44, Laing Island, before channel, dredged, 25-35 m, leg. J. Pierret, 25.ix.1980, 1 valve, IG 26.253; PNG 1980: 49, Mililat (N of Madang), Wongat reef, E-side, 3-5 m, leg. J. Pierret, iii.1980, 1 valve, IG 26.080; PNG 1980: 123, Duangit reef, hand-dredged, 40-42 m, leg. J. Pierret, 28.v.1980, 1 valve, IG 26.080; PNG 1980: 236, Laing Island (Madang prov.), W-side, hand-dredged, 17 m, leg. D. Christensen, 4.vi.1980, 1 valve, IG 26.080; PNG 1980: 251, Laing Island (Madang prov.), W-side, diving, hand-dredged, 25-30 m, leg. J. Pierret, 6.vi.1980, 1 valve, IG 26.080; PNG 1980: 258, Laing Island (Madang prov.), W-side, diving, hand-dredged, 18-20 m, leg. D. Christensen, 6.vi.1980, 2 valves, IG 26.080; PNG 1981: 66, Gwamblisim reef, dredged, 20-25 m, leg. J. Pierret, 27.x.1980, 1 specimen, IG 26.253.

Distribution: Throughout the Indo-Pacific. Living byssally attached under rocks or coral slabs or amongst coral rubble on sandy or muddy sediments in the littoral.

Genus **Juxtamusium** Iredale, 1939

Juxtamusium Iredale, 1939: 368.
Type species (by original designation): *Juxtamusium oblectatum* Iredale, 1939 [= *Pecten (Chlamys) coudeini* Bavay, 1903]. Recent. Indo-West Pacific.

Juxtamusium coudeini (Bavay, 1903)

Pecten (Chlamys) coudeini Bavay, 1903: 401, pl. 8, f. 3-4. Bavay, 1904: 206. Dautzenberg & Bavay, 1912: 17.
Juxtamusium oblectatum Iredale, 1939: 368. Waller, 1972: 250, 252, 254, f. 128-133, 135.
Juxtamusium coudeini (Bavay). Waller, 1984: 211. Dijkstra, 1984: 8, figs.; 1985: 10, figs.; 1990: 3, figs.

Type material: Holotype KBIN IG 10591.

Type locality: New Caledonia.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 42, Mililat (N. of Madang), Boys house, small reef, sand, debris, hand-dredged, 20 m, leg. J. Pierret, 9.iii.1979, 1 live specimen, IG 26.080; PNG 1979: 51, Nagada (N of Madang), Wongat reef, sand, dredged, 25 m, leg. J. Pierret, 2.xi.1979, 1 live specimen, IG 26.086; PNG 1979: 63, Nagada (N of Madang), N Wongat reef, dredged, 25 m, leg. j. Pierret, 10.xi.1979, 1 specimen + 1 valve, IG 26.086; PNG 1979: 74, Nagada (N of Madang), Tab Island, dredged, 5-7 m, leg. J. Pierret, 19.xi.1979, 1 valve, IG 26.080; PNG 1980: 26, Hansa Bay, Laing Island, square J2, sand, coral rubble, dredged, 30-35 m, leg. J. Pierret, 6.ix.1980, 1 live specimen, IG 26.253.

Distribution: Throughout the western Indian Ocean and the western and southwestern Pacific. Living byssally attached to corals or amongst sandy sediments at littoral to sublittoral depths.

Remarks: The present specimens are similar to the type material, although more brightly coloured. The conchological characters of the examined material (AMS, MNHN) are rather constant.

Grau (1959: 123) treated *J. oblectatum* [= *J. coudeini*] as a junior synonym of *Juxtamusium maldivense* (E. A. Smith, 1903). Waller (1972: 252), however, clearly determined the distinct shell characters of both species. Recently Waller (1986: 40) placed *Juxtamusium* in the tribe Decatopectinini.

Juxtamusium maldivense (E. A. Smith, 1903)
(Plate 3, figs. 1-3)

Pecten maldivensis E. A. Smith, 1903: 622, pl. 36, f. 19-20.
Juxtamusium maldivense (Smith). Iredale, 1939: 368. Waller, 1972: 250, pl. 7, f. 111-127, pl. 8, f. 134. Dijkstra, 1984: 8, figs.; 1990: 4, figs.

Type material: Lectotype BMNH 1903.9.17.49, designated by Waller (1972: 250).

Type locality: Maldive Islands, Indian Ocean.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 18, Nagada (N of Madang), Wongat reef, coral, algae, sand, dredged, 25-30 m, leg. J. Pierret, 6.ix.1979, 1 live specimen, IG 26.086; PNG 1979: 40B, Mililat (11 km N of Madang), small reef S, hand-dredged, 15-20 m, leg. J. Pierret, 8.iii.1979, 1 valve, IG 26.080.

Distribution: Throughout the Indo-West Pacific. Living amongst coral rubble on sandy sediments at littoral to sublittoral depths.

Remarks: The present specimen is similar to the type material, although somewhat more irregularly ribbed. Material examined (BMNH, HD, MNHN, ZMA) is rather variable in shell morphology (see also Waller, 1972: 252).

Genus **Mirapecten** Dall, Bartsch & Rehder, 1938

Mirapecten Dall, Bartsch & Rehder, 1938: 84.
Type species (by original designation): *Mirapecten thaanumi* Dall, Bartsch & Rehder, 1938 [= *Pecten mirificus* Reeve, 1853]. Miocene-Recent. Indo-West Pacific.

Mirapecten mirificus (Reeve, 1853)
(Plate 3, figs. 4-6)

Pecten mirificus Reeve, 1853: sp. 104 [text unpag.], pl. 26, f. 104.
Mirapecten mirificus (Reeve). Dijkstra, 1991: 48 [synonymy, references, discussion].

Type material: Holotype BMNH 1950.11.14.46.

Type locality: "Amboyna" [= Ambon, Indonesia].

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1978: 44, Madang, leg. B. Tursch, 1978, 2 valves, IG 25.955; PNG 1979: 38, Nagada (N of Madang), Wongat reef, dredged, 25 m, leg. J. Pierret, 22.ix.1979, 2 valves, IG 26.086; PNG 1979: 45, Nagada (N of Madang), Large reef, dredged, 25-30 m, leg. J. Pierret, 27.x.1979, 1 valve, IG 26.086; PNG 1979: 117, Duangit reef,

hand-dredged, 40-46 m, leg. J. Pierret, 27.v.1979, 1 valve, IG 26.080; PNG 1980: 29, SE Duangit, dredged, 52 m, leg. J. Pierret, 10.ix.1980, 1 valve, IG 26.253; PNG 1980: 59, Wanginem 2, dredged, 40 m, leg. J. Pierret, 22.x.1980, 1 valve, IG 26.253; PNG 1980: 77, SE Laing Island, dredged, 45 m, leg. J. Pierret, 21.xi.1980, 1 valve, IG 26.227; PNG 1981: 392, hand-dredged, 57 m, leg. J. Pierret, 28.v.1981, 2 valves, IG 26.373; Duangit, dredged, 45 m, 1 valve, ex Tursch coll. (HD).

Distribution: Western Indian Ocean, western and southwestern Pacific. Living amongst coral rubble on sandy sediments at littoral to sublittoral depths.

Mirapecten rastellum (Lamarck, 1819)
(Plate 3, figs. 7-8)

Pecten rastellum Lamarck, 1819: 166, sp. 14.
Mirapecten rastellum (Lamarck). Dijkstra, 1991: 48 [synonymy, references, discussion]. Dijkstra, 1994: 474 [additional references, discussion].

Type material: Holotype MHNG 1088/24.

Type locality: "Habite les mers du Nord" [error]. A new type locality was designated by Dijkstra (1994: 474): Off Punta Engano, Mactan, Cebu, Philippines.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 5, Nagada (N of Madang), Tab Island, dredged, 10 m, leg. J. Pierret, 30.viii.1979, 1 valve, IG 26.086; PNG 1979: 12, Nagada (N of Madang), Wongat reef, top of reef, diving, 5 m, leg. J. Pierret, 2.ix.1979, 1 valve, IG 26.086; PNG 1979: 23, Laing Island, SW square H1, hand-dredged, 20 m, leg. J. Van Goethem and J. Pierret, 18.v.1979, 1 valve, IG 26.080; PNG 1979: 117, Duangit reef, hand-dredged, 40-46 m, leg. J. Pierret, 27.v.1979, 1 valve, IG 26.080; PNG 1979: 124, E Duangit reef, diving, hand-dredged, 40-46 m, leg. J. Pierret, 28.v.1979, 1 valve, IG 26.080; PNG 1979: 258, Laing Island (Madang prov.), W-side, diving, hand-dredged, 18-20 m, leg. D. Christensen, 6.vi.1979, 2 valves, IG 26.080; PNG 1979: 343, N Duangit reef, diving, hand-dredged, 25-32 m, leg. J. Pierret, 17.vi.1979, 1 valve, IG 26.080; PNG 1980, Laing Island, dredged, 30 m, leg. J. Pierret, 29.v.1980, 1 valve, IG 26.253; PNG 1980: 22, Manam Island, Borda reef, dredged, 50 m, leg. J. Pierret, 17.viii.1980, 2 valves, IG 26.253; PNG 1980: 43, S Duangit, E-edge, dredged, 45-50 m, leg. J. Pierret, 25.ix.1980, 1 valve, IG 26.253; PNG 1980: 44, Laing Island, before channel, dredged, 25-35 m, leg. J. Pierret, 25.ix.1980, 1 valve, IG 26.253; PNG 1980: 69, Purar reef, 10 m, leg. J. Pierret, 29.x.1980, 1 specimen, IG 26.253; PNG 1980: 89, NE Duangit, S-side, dredged, 40 m, leg. J. Pierret, 9.xii.1980, 1 valve, IG 26.227; PNG 1981: 16, leg. J. Bouillon and J. Pierret, 1981, 1 live specimen, IG 26.527; PNG 1981: 431, barrier reef, epifauna and commensal fauna, dredged, 58 m, leg. A. Capart et al., 4.vii.1981, 1 live specimen, IG 26.373; Duangit, dredged, 45 m, 1 valve, ex Tursch coll. (HD).

Distribution: Throughout the Indo-Pacific. Living amongst coral rubble on sandy sediments at littoral to sublittoral depths.

Plate 3.

Figures 1-3. *Juxtamusium maldivense* (E.A. Smith, 1903). KBIN, Mililat, 15-20 m, H 20.1 mm, rv. 1. Right valve, exterior. 2. Right valve, interior. 3. Right valve, exterior, postero-marginal section (scale bar 1 mm). **4-6.** *Mirapecten mirificus* (Reeve, 1853). KBIN, Laing Island, 45 m, H 26.3 mm, rv. 4. Right valve, exterior. 5. Right valve, interior. 6. Right valve, exterior, lamellae postero-marginal section (scale bar 1 mm). **7-8.** *Mirapecten rastellum* (Lamarck, 1819). KBIN, Purar reef, 10 m, H 40.9 mm, db. 7. Left valve, exterior. 8. Right valve, exterior.

Tribe **PECTININI** Lamarck, 1819
Genus **Minnivola** Iredale, 1939

Minnivola Iredale, 1939: 363.
Type species (by original designation): *Minnivola isomeres* Iredale, 1939. Miocene-Recent. Indo-West Pacific (Hayami, 1989: 16).

Minnivola pyxidata (Born, 1778)

Ostrea pyxidata Born, 1778: 93; 1780: 108, pl. 6, f. 5-6.
Ostrea sulcata Gmelin, 1791: 3325 (not Müller, 1776, not Born, 1778).
Pecten pyxidatus (Born). G. B. Sowerby 2nd, 1842: 49, pl. 12, f. 24-25. Reeve, 1853: sp. 96 (text unpag.), pl. 24, f. 96a-b. Lynge, 1909: 153. Dautzenberg & Bavay, 1912: 3. Abbott & Dance, 1982: 304, fig.
Pecten crebricostatus Philippi, 1845: 100, pl. 1, f. 2.
Pecten (Minnivola) pyxidatus (Born). Springsteen & Leobrera, 1986: 326, pl. 93, f. 2. Wang, 1989: 180, f. 5.1-2.

Type material: Holotype NHMW 1822.

Type locality: Unknown. Type locality will be designated in a forthcoming publication on type material described by Born.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1980: 61, SE Wanginem 2, dredged, 40 m, leg. J. Pierret, 23.x.1980, 1 valve, IG 26.253.

Distribution: Northern Indian Ocean, western and southwestern Pacific. Living amongst seaweed on muddy sand sediments at littoral to sublittoral depths. Judging from the absence of ctenolium in the mature stage, specimens are probably not byssally attached.

Remarks: The present specimen is similar to the type material. *Minnivola isomeres* Iredale, 1939 from Queensland (Australia) is probably only an ecomorphical form of *M. pyxidata*. It differs somewhat from the present species by a slightly more concave left valve, fewer radial riblets and a more uniform colour. Intermediate variations, however, are also observed (AMS, HD, MNHN, NNM, WAM, ZMA).

Genus **Serratovola** Habe, 1951

Serratovola Habe, 1951: 81.
Type species (by original designation): *Pecten tricarinatus* Anton, 1838 (not Defrance, 1825) [= *Pecten rubicundus* Recluz in Chenu, 1843]. Pliocene-Recent. Indo-West Pacific (Hayami, 1989: 16).

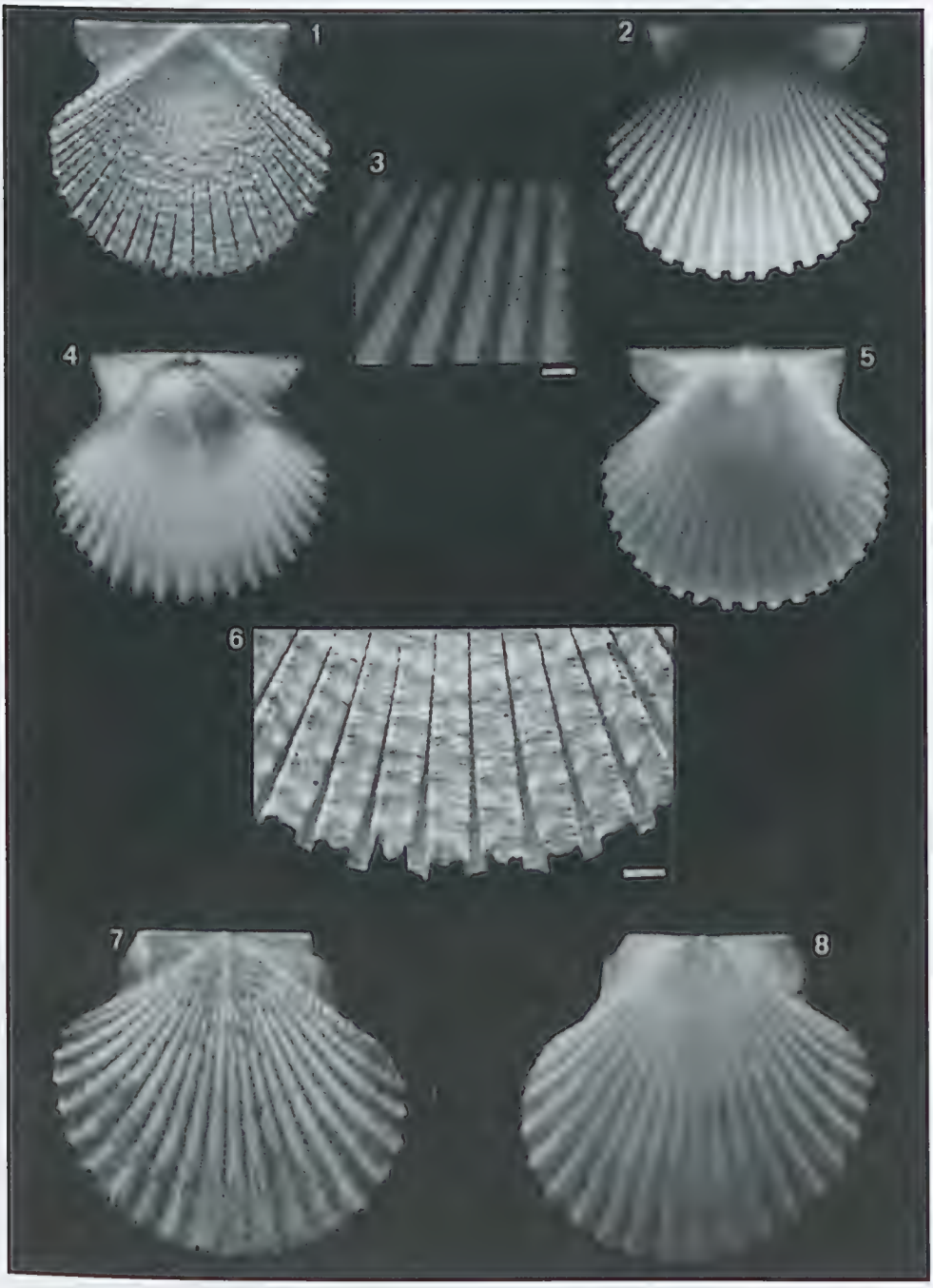


Plate 4.
Figures 1-6. *Serratovola pallula* n. sp. Holotype KBIN 25.955.471, S of Duangit, 60 m, H. 16.8 mm, db. 1. Left valve, exterior. 2. Right valve, exterior. 3. Right valve, exterior, postero-marginal section (scale bar 1 mm). 4. Left valve, interior. 5. Right valve, interior. 6. Left valve, exterior, ventral marginal section (scale bar 1 mm). **7-8.** *Pecten tricarinatus* Anton, 1838. Lectotype SMTD 6937, H 28.9 mm, db. 7. Left valve, exterior. 8. Right valve, exterior.

Remarks: Habe (1951) introduced *Serratovola* as an extant genus, but Hertlein (1969: N367) treated it as a synonym of *Pecten*. *Serratovola* species, however, differ from *Pecten* by a suborbicular shape, subequal auricles, and the hollow sections in the radial costae.

Serratovola pallula n. sp.
(Plate 4, figs. 1-6)

Description: Shell moderately small, up to 17 mm high, inequivalve, equilateral, left valve somewhat concave, right valve convex, auricles nearly equal.

Left valve sculptured with 19 broad angulate radial costae with close interstices near the ventral margin. In early dissoconch stage exterior smooth apart from a few concentric growth lines. Radial ribs with fine interstitial concentric lamellae start ca. 1.5 mm beneath umbonal top. On central dissoconch hollow sections formed on both sides of radial costae, and interstices narrow grooves. Approximately 5 mm above the ventral margin in adults small interstices are exposed, diverging near margin, with concentric lamellae. Anterior auricle somewhat longer (7.8 mm) than posterior one (6.4 mm). Both auricles with fine concentric lamellae and few weak radial riblets, the latter more prominent anteriorly, near disc boundary. Hinge line straight. Outer ligament dark brown.

Right valve sculptured with 20, somewhat rounded, radial costae, which are more angulate near periphery. Ribs are similar to left valve. Interstices wider than on left valve, with addition of concentric lamellae. Auricles with weak radial riblets with overrunning closely arranged concentric irregular lamellae. Hinge line straight with fine spines. Byssal notch rather small. Only one active tooth visible on suture (ctenolium). Resilial insertion triangular.

Left valve dotted creamy-brown on brown, right valve uniform creamy-white.

Type material: Holotype (H 16.8, L 18.0, D 5.9 mm) KBIN 25.955. 471.

Type locality: PAPUA NEW GUINEA: Hansa Bay, S of Duangit, dredged, 60 m, leg. B. Tursch.

Distribution: Papua New Guinea and northern Australia (AMS, QM, WAM) (material under study).

Etymology: The radial costae of the shell are strongly angulate [Lat. pallula (substantivum: femininum) = small curtain].

Remarks: S. pallula differs from *S. gardineri* (E. A. Smith, 1903), known from the Maldive Islands, by a more concave left valve. The radial costae of the left valve are angular, that of the latter species more acute. The interstices of the left valve are very small, of *S. gardineri* broad. Interstitial concentric lamellae are not produced in the latter species and the radial ribs near the ventral margin are more rounded rather than angulate. The right valve in *S. pallula* is more convex

and the ribs more closely arranged than in *S. gardineri*, and the hollow sections of the radial costae are somewhat larger. *S. pallula* differs from *S. rubicunda* by more angulate radial costae and smaller interstices of the left valve. The left valve of *S. rubicunda* is slightly convex, that of *S. pallula* concave. Concentric lamellae of *S. rubicunda* are more prominent. Hollow sections of the radial costae of the right valve are absent or much weaker in *S. rubicunda* and the ribs are more rounded near the ventral margin. The left valve of *S. rubicunda* is maculated red rather than spotted.

Material from northwestern and northern Australia (AMS, QM, WAM) is very similar to the type material, although the radial costae are somewhat smaller and the interstices somewhat broader (under study).

Serratovola rubicunda (Recluz in Chenu, 1843)
(Plate 4, figs. 7-8)

Pecten tricarinatus Anton, 1838: 19 (not Defrance, 1825). Philippi, 1845: 99, pl. 1, f. 4. Küster & Kobelt, 1888: 80, pl. 20, f. 4. Dautzenberg & Bavay, 1912: 3.
Pecten asper G. B. Sowerby 2nd, 1842: 50, pl. 19, f. 196-197 (not Lamarck, 1819). Reeve, 1852: sp. 10 [text unpag.], pl. 2, f. 10.
Pecten rubicundus Recluz in Chenu, 1843: 3, pl. 7, f. 4-5 (new name for *P. asper* Sowerby).
Pecten passerinus Hinds, 1845: 61 (new name for *P. asper* Sowerby).
Pecten (Vola) asper Sowerby. Küster & Kobelt, 1888: 238, pl. 63, f. 2-3.
Pecten (Serratovola) tricarinatus Anton. Habe, 1981: 70.
Serratovola tricarinata (Anton). Kuroda & Habe, 1981: 70. Abbott & Dance, 1982: 304, fig.
Serratovola tricarnatus [sic] (Anton). Wang, 1989: 181, pl. 1, f. 3-4.

Type material: Lectotype (H 28.9, L 31.1, D 7.9mm) SMTD 6937, here designated.

Type locality: China.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1976: 216, Laing Island, dredged, 50-100 m, leg. A. Capart, 31.iii.1976, 1 valve, IG 25.485; PNG 1977, Duangit reef, 45 m, leg. B. Tursch and J. Pierret, 1977, 1 valve, IG 25.930; PNG 1981: 281, Laing Island, E-side, hand-dredged, 50 m, leg. J. Pierret, 12.vi.1981, 2 valves, IG 26.373; off Awar strip, dredged, 75 m, 1 specimen, ex Tursch coll. (HD).

Distribution: Northern Indian Ocean, western and southwestern Pacific. Living on muddy or sandy sediments at littoral to sublittoral depths.

Remarks: The present specimens are similar to the type material of *P. tricarinatus* Anton.

Dijkstra (1991: 49) considered *Serratovola gardineri* (E. A. Smith, 1903) from the Maldive Islands as a synonym of *P. tricarinatus*. After a recent inspection of the rediscovered type material of *P. tricarinatus* Anton (SMTD), however, it

transpires that *S. gardineri* differs from *P. tricarinatus* by having more prominent, closely arranged, angular radial costae, and fewer radial ribs (18). *S. gardineri* is closest to the new *Serratovola* species described herein.

Subfamily **CHLAMYDINAE** von Teppner, 1922
Tribe **CHLAMYDINI** von Teppner, 1922
Genus **Coralichlamys** Iredale, 1939

Coralichlamys Iredale, 1939: 355.
Type species (by original designation): *Coralichlamys acroporicola* Iredale, 1939 [= *Pecten madreporarum* G.B. Sowerby 2nd, 1842]. Miocene-Recent. Indo-West Pacific.

Remarks: Waller (1993: 199) divided the subfamily into four extant tribes, viz. Chlamydini von Teppner, 1922, Crassadomini Waller, 1993, Mimachlamydini Waller, 1993, and Aequipectinini Waller, 1993. The probable monotypic, coral dwelling genus in the Indo-West Pacific could belong to the Chlamydini (Waller, 1993: 203). This genus is still under study.

Coralichlamys madreporarum (G.B. Sowerby 2nd, 1842)

Pecten madreporarum G.B. Sowerby 2nd, 1842: 68, pl. 14, f. 68.
Coralichlamys madreporarum (Sowerby). Dijkstra, 1991: 32 [synonymy, references, discussion].

Type material: Three syntypes BMNH 1995083.

Type locality: "Red Sea". Reeve (1853: spec. 117) mentioned this species only from "Java".

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: 1978, Mililat, in situ on *Acropora* spec., leg. J. Pierret and D. Zimmermann, 1978, 1 specimen, IG 25.930.

Distribution: Throughout the Indo-W. Pacific, from southern Japan to New Caledonia. Living embedded between branches of *Acropora* in the littoral.

Genus **Laevichlamys** Waller, 1993

Laevichlamys Waller, 1993: 204.
Type species (by original designation): *Pecten multisquamatus* Dunker, 1864; Recent, tropical western Atlantic.

Laevichlamys andamanica (Preston, 1908)

Chlamys andamanica Preston, 1908: 204, pl. 14, f. 19. Dijkstra, 1991: 29, f. 90 [synonymy, references, discussion].

Plate 5.
Figures 1-4. *Laevichlamys irregularis* (Sowerby, 1842). HD, Laing Island, H 20.1 mm, db. 1. Left valve, exterior. 2. Right valve, exterior. 3. Left valve, interior. 4. Right valve, interior. **5-8.** *Laevichlamys mollita* (Reeve, 1853). HD, Boesa Island, H 44.0 mm, db. 5. Left valve, exterior. 6. Right valve, exterior. 7. Left valve, interior. 8. Right valve, interior.

Type material: Holotype ZSI M4042/1.

Type locality: Andaman Islands.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1980: 5, Nagada (N of Madang), Tab Island, dredged, 10 m, leg. J. Pierret, 30.VIII.1979, 1 valve, IG 26.086.

Distribution: Northern Indian Ocean and Indo-West Pacific. Living on sandy bottoms amongst coral rubble in the littoral.

Remarks: The present specimen is more suborbicular in shape than the type specimen, which is more elongate. Intermediate variations, however, are also observed (MNHN, ZSI).

Laevichlamys irregularis (G. B. Sowerby 2nd, 1842)
(Plate 5, figs. 1-4)

Pecten irregularis G. B. Sowerby 2nd, 1842: 69, pl. 13, f. 51-52.
Chlamys irregularis (Sowerby). Dijkstra, 1991: 31 [synonymy, references, discussion].

Type material: Holotype BMNH 1950.11.14.39.

Type locality: "Eastern Seas" [= Indo-West Pacific].

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 45A, Mililat (N of Madang), Kerry Ann N, small reef, sandy mud, hand-dredged, 25 m, leg. J. Pierret, 14.III.1979, 1 live specimen, IG 26.080; PNG 1979, Wanginem E, under coral slabs, 7-10 m, leg. J. Pierret, 7.VII.1979, 1 live specimen, IG 26.086; PNG 1979: 66, Nagada (N of Madang), Tab reef, top of reef, 3 m, leg. J. Pierret, 12.XI.1979, 2 live specimens, IG 26.086; PNG 1980: 278, Legoarant Island (Madang prov.), N Island, diving, hand-dredged, 20-30 m, leg. J. Pierret, 9.VI.1979, 1 valve, IG 26.080; PNG 1980: 314, Legoarant Island (Madang prov.), S Island, diving, hand-dredged, 10-12 m, leg. D. Christensen, 13.VI.1979, 1 valve, IG 26.080; PNG 1980: 343, Duangit reef (Madang prov.), hand-dredged, 25-32 m, leg. J. Pierret, 17.VI.1979, 1 valve, IG 26.080; PNG 1980, Laing Island J5, 5 m, leg. J. Pierret, VII.1979, 1 specimen, IG 26.086; PNG 1980, Purar reef, shallow water, leg. J. Pierret, VII.1979, 1 specimen, IG 26.086; PNG 1980, Duangit W, 5 m, leg. J. Pierret, 2.VII.1979, 2 valves, IG 26.086; PNG 1980: 5, Nagada (N of Madang), Tab Island, dredged, 10 m, leg. J. Pierret, 30.VIII.1979, 7 valves, IG 26.086; PNG 1980: 21, Manam, Borda reef, under coral, 10 m, leg. J. Pierret, 16.VIII.1980, 1 live specimen, IG 26.253; PNG 1980: 197, Nubia, dredged, 10-20 m, leg. B. Tursch and J. Pierret, 1 specimen, IG 26.132; PNG 1981: 3, Purar reef, 8-10 m, leg. J. Pierret, 9.VII.1980, 1 specimen, IG 26.253; PNG 1981: 5, Purar reef, 8-10 m, leg. J. Pierret, 10.VII.1980, 1 specimen, IG 26.253; PNG 1981: 12, SE Duangit, dredged, 50-52 m, leg. J. Pierret, 21.XI.1980, 1 valve, IG 26.227; PNG

1981: 379, on top of wreck, 20 m, leg. J. Pierret, 26.VI.1981, 1 live specimen, IG 26.373; Laing Island, Bi-263, 2 specimens, ex Tursch coll. (HD).

Distribution: Throughout the Indo-West and central Pacific. Byssally attached under coral slabs or amongst coral rubble on sandy or muddy sediments at littoral to sublittoral depths.

Laevichlamys mollita (Reeve, 1853)
(Plate 5, figs. 5-8)

Pecten mollitus Reeve, 1853: text unpag., sp. 100, pl. 25, f. 100.
Chlamys mollita (Reeve). Kira, 1960: 121, pl. 18, f. 8. Dijkstra, 1983: 5, figs.

Type material: Two syntypes BMNH 1995081. The largest specimen in the type lot labelled "Celebes" does not belong to the type series.

Type locality: Japan.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: Boesa Island, W5, 1 specimen, ex Tursch coll. (HD).

Distribution: Indo-West Pacific. Living byssally attached under coral boulders or amongst coral rubble on sandy sediments in the littoral.

Remarks: The present specimen is similar to the type material, although more brightly coloured. Material examined (HD, ZMA) are very variable of colour. Juveniles of *L. mollita* could be easily confused with *L. irregularis*, which has irregularly arranged radial riblets, and *L. aliae* (Dijkstra, 1988), which is more oblong and has less radial riblets than *L. mollita*.

Laevichlamys squamosa (Gmelin, 1791)
(Plate 6, figs. 1-4)

Ostrea squamosa Gmelin, 1791: 3319.
Chlamys squamosa (Gmelin). Dijkstra, 1991: 31 [synonymy, references, discussion].

Type material: Lectotype BMNH (Sloane coll.), designated by Dijkstra (1991: 32).

Type locality: Unknown. Here designated to Queensland, Australia. Specimens from that region are very similar to the type specimen (AMS, HD, ZMA).

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1980, Mililat 35B (N of Madang), N of small reef, hand-dredged, 12-15 m, leg. J. Pierret, 5.III.1979, 1 valve, IG 26.080; PNG 1980: 9, Nagada (N of Madang), Tab reef, dredged, 20 m, leg. J. Pierret, 1.IX.1979, 1 valve, IG 26.086; PNG 1980: 12, Nagada (N of Madang), Wongat reef, 5 m, leg. J. Pierret, 2.IX.1979, 1 valve,

IG 26.086; PNG 1980: 15, Nagada (N of Madang), Wongat reef, dredged, 25-30 m, leg. J. Pierret, 4.IX.1979, 1 specimen, IG 26.086; PNG 1980: 18, Nagada (N of Madang), Wongat reef, dredged, 25-30 m, leg. J. Pierret, 6.IX.1979, 1 specimen, IG 26.086; PNG 1980: 30, Nagada (N of Madang), Gosem Island, dredged, 20 m, leg. J. Pierret, 17.IX.1979, 1 valve, IG 26.086; PNG 1980: 38, Nagada (N of Madang), Wongat reef, dredged, 25 m, leg. J. Pierret, 22.IX.1979, 1 valve, IG 26.086; PNG 1980: 48, Nagada (N of Madang), Gosem reef n° 3, 3-5 m, leg. J. Pierret, 30.X.1979, 1 specimen, IG 26.086; PNG 1980: 61, Nagada (N of Madang), N of Wongat reef, dredged, 25 m, leg. J. Pierret, 9.XI.1979, 1 valve, IG 26.086; PNG 1980: 75, Nagada (N of Madang), Tab reef, 10 m, leg. J. Pierret, 20.XI.1979, 1 specimen, IG 26.086; Laing Island, 1 specimen, ex Tursch coll. (HD).

Distribution: Throughout the Indo-West Pacific. Living byssally attached to rocks and corals, or in sandy or muddy sediments in the littoral.

Genus **Pedum** Lamarck, 1799

Pedum Lamarck, 1799: 88.
Type species (designation by monotypy): *Ostrea spondyloidea* Gmelin, 1791. Recent. Indo-West Pacific.

Pedum spondyloideum (Gmelin, 1791)

Ostrea spondyloidea Gmelin, 1791: 3335.
Pedum spondyloideum (Gmelin). Dijkstra, 1991: 40 [synonymy, references].

Type material: Holotype ZMUC BIV-57.

Type locality: India.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: Laing Island, in cavities in *Porites*; Hansa Bay, Laing Island, 1 live specimen, ex Tursch coll. (HD).

Distribution: Throughout the Indo-Pacific. Living in cavities of massive heads of coral *Porites lutea* Milne-Edwards and Haime in the littoral.

Remarks: The present specimen is similar to the type material. Material examined (AMS, BMNH, KBIN, MNHN, NNM, WAM, ZMA, ZMUC) is very variable in shape, due to development in cavities in *Porites*. For further information on morphology, ecology and distribution see Yonge (1967), Waller (1972) & Kleemann (1990).

Genus **Semipallium** [Jousseaume] Lamy, 1928

Semipallium [Jousseaume] Lamy, 1928: 169.
Type species (by original designation): *Pecten tigris* Lamarck, 1819. Miocene-Recent. Indo-West Pacific (Hayami, 1989: 16).

Plate 6.

Figures 1-4. *Laevichlamys squamosa* (Gmelin, 1791). HD, Laing Island, H 15.8 mm, juvenile db. 1. Left valve, exterior. 2. Right valve, exterior. 3. Left valve, interior. 4. Right valve, interior. **5-8.** *Semipallium dianae* (Crandall, 1979). HD, Laing Island, H 48.9 mm, db. 5. Left valve, exterior. 6. Right valve, exterior. 7. Left valve, interior. 8. Right valve, interior.

Semipallium barnetti Dijkstra, 1988
(Plate 7, fig. 1)

Semipallium barnetti Dijkstra, 1988: 16, figs.

Type material: Holotype ZMA Moll. 388044.

Type locality: Off Punta Engano, Magellan Bay, Mactan Island, Cebu, Philippines.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 9, Nagada (N of Madang), Tab reef, dredged, 20 m, leg. J. Pierret, 1.ix.1979, 1 valve, IG 26.086; PNG 1979: 11, Nagada (N of Madang), Wongat reef, dredged, 30 m, leg. J. Pierret, 2.ix.1979, 1 valve, IG 26.086; PNG 1979: 43B, Mililat (N of Madang), small reef, hand-dredged, 25 m, leg. J. Pierret, 12.iii.1979, 1 specimen, IG 26.080; PNG 1979: 46, Nagada (N of Madang), Wongat reef, coral sand, dredged, 25-30 m, leg. j. Pierret, 29.x.1979, 1 live specimen, IG 26.086; PNG 1979: 52, Nagada (N of Madang), Wongat reef, coral sand, dredged, 5-20 m, leg. J. Pierret, 3.xi.1979, 1 live specimen, IG 26.086; PNG 1979, Laing Island, Besarpap reef, dredged, 40-45 m, leg. J. Pierret, 8.xii.1979, 1 specimen, IG 26.370; PNG 1980: 42, Laing Island, C1, before channel, dredged, 25-35 m, leg. J. Pierret, 24.ix.1980, 2 valves, IG 26.253; PNG 1981: 392, Wanginem reef, hand-dredged, 43 m, leg. J. Pierret, 28.v.1981, 1 valve, IG 26.373.

Distribution: Southwestern Pacific, from the Philippines, Indonesia, Papua New Guinea to the Solomon Islands. Living amongst coral rubble on sandy sediments at littoral to sublittoral depths.

Remarks: The present specimens are similar to the type material. Material examined (HD, KBIN, ZMA) the secondary radial riblets are somewhat variable in number. Juveniles could easily be confused with *Semipallium dringi* (Reeve, 1853) and *Semipallium fulvicostatum* (A. Adams & Reeve, 1850).

Semipallium dianae (Crandall, 1979)
(Plate 6, figs. 5-8)

Chlamys dianae Crandall, 1979: 114, f. 3-8.
Semipallium dianae (Crandall). Dijkstra, 1991: 38 [references, discussion].

Type material: Holotype TMMT 7911.

Type locality: Ryukyu Islands, Japan.
Material examined: The type material. PAPUA NEW GUINEA: Hansa Bay, Laing Island, 1 specimen, ex Tursch coll. (HD).

Distribution: Western and southwestern Pacific. Living attached or free 'swimming' amongst coral rubble on sand in the littoral.

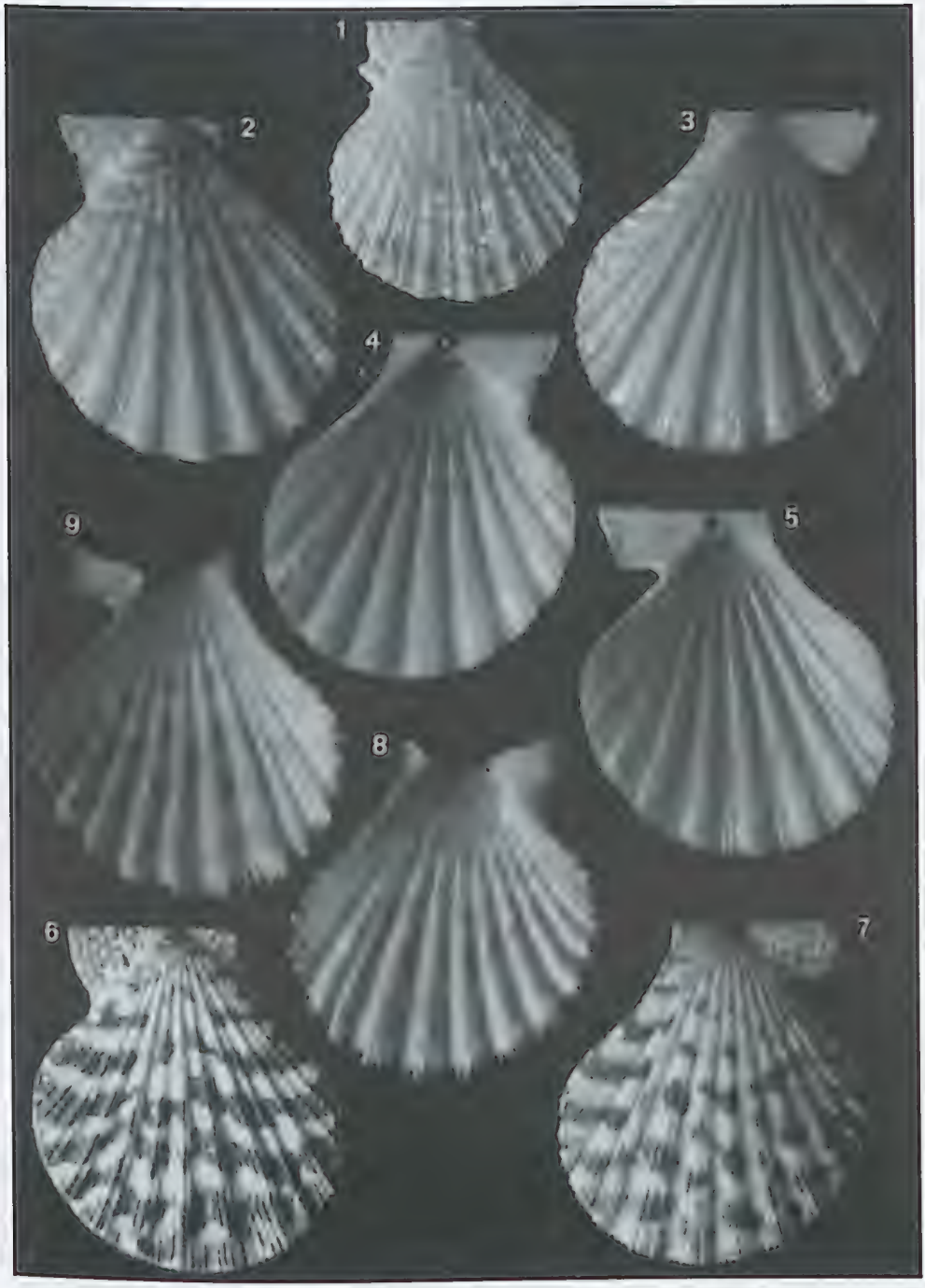


Plate 7.

Figure 1. *Semipallium barnetti* Dijkstra, 1988. KBIN, Mililat, 25 m, H 18.0 mm, lv. **2-5.** *Semipallium fulvicostatum* (Adams and Reeve, 1850). KBIN, Purar reef, 10m, H 31.0 mm, db. 2. Left valve, exterior. 3. Right valve, exterior. 4. Left valve, interior. 5. Right valve, interior. **6-9.** *Semipallium tigris* (Lamarck, 1819). HD, Laing Island, H 39.0 mm, db. 6. Left valve, exterior. 7. Right valve, exterior. 8. Left valve, interior. 9. Right valve, interior.

Remarks: The present specimen is similar to the type material, although the coloration of the present specimen is somewhat darker and the radial riblets on the primary costae are developed earlier.

Semipallium fulvicostatum (A. Adams & Reeve, 1850)
(Plate 7, figs. 2-5)

Pecten fulvicostatus A. Adams & Reeve, 1850: 74, pl. 21, f. 11.
Semipallium fulvicostatum (Adams & Reeve). Dijkstra, 1991: 38 [synonymy, references, discussion].

Type material: Holotype BMNH 1950.11.14.31.

Type locality: "Sooloo Archipelago" [= Sulu Archipelago, Philippines].

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1976, H3, trawled, leg. B. Tursch and J. Pierret, x.1976, 1 valve, IG 26.132; PNG 1976: 223, Laing Island, dredged, 20 m, leg. A. Capart, 2.iv.1976, 1 valve, IG 25.485; PNG 1977: 182, Laing Island, outside reef, hand-dredged, leg. J. Van Goethem, 23.v.1977, 1 valve, IG 25.681; PNG 1980, Laing Island, E1, leg. J. Pierret, v.1980, 2 valves, IG 26.253; PNG 1980:58, NE Duangit, dredged, 40 m, leg. J. Pierret, 21.x.1980, 1 valve, IG 26.253; PNG 1980: 69, Purar reef, 10 m, leg. J. Pierret, 29.x.1980, 1 specimen, IG 26.253.

Distribution: Throughout the western and southwestern Pacific to French Polynesia. Living attached under coral slabs, amongst coral rubble on sand at littoral to sublittoral depths.

Semipallium tigris (Lamarck, 1819)
(Plate 7, figs. 6-9)

Pecten tigris Lamarck, 1819: 171.
Semipallium tigris (Lamarck). Dijkstra, 1991: 40 [references, discussion]. Dijkstra, 1994: 482, f. 70-74 [additional references and discussion].

Type material: Lectotype MNHN, designated by Dijkstra (1994: 483).

Type locality: "l'Océan indien?"

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1976, Laing Island, dredged, 30 m, leg. J. Pierret, vii.1979, 2 specimens, IG 26.086; PNG 1979: 22, Nagada (N of Madang), Tab reef, 3-5 m, leg. J. Pierret, 11.ix.1979, 1 valve, IG 26.086; PNG 1979: 48, Nagada (N of Madang), Gosem reef 3, coral, 3-5 m, leg. J. Pierret, 30.x.1979, 1 live specimen, IG 26.086; PNG 1979: 58, Nagada (N of Madang), Great Gosem reef, 3 m, leg. J. Pierret, 7.xi.1979, 1 valve, IG 26.086; PNG 1979: 64, Nagada (N of Madang), Gosem reef, 3 m, leg. J. Pierret, 10.xi.1979, 1 live specimen, IG 26.086; PNG 1979: 66, Nagada (N of Madang), Tab

reef, under reef, 3 m, leg. J. Pierret, 12.xi.1979, 1 live specimen, IG 26.086; PNG 1980: 69, Purar reef, 10 m, leg. J. Pierret, 29.x.1980, 1 specimen, IG 26.253; Laing Island, B1-198, 2 specimens, ex Tursch coll. (HD).

Distribution: Throughout the Indo-Pacific. Living byssally attached under coral boulders or amongst coral rubble on sand in the littoral.

Remarks: The present specimens are similar to the type material, although the specimens from the Hansa Bay have one or two more radial costae and the concentric lamellae between the radial ribs on the left valve are more prominent. Intermediate variations, however, were also examined (AMS, BMNH, HD, KBIN, MNHN, NNM, ZMA).

Tribe **MIMACHLAMYDINI** Waller, 1993
Genus **Mimachlamys** Iredale, 1929

Mimachlamys Iredale, 1929: 162.
Type species (by original designation): *Pecten asperrimus* Lamarck, 1819; Eocene-Recent (Waller, 1991: 32), eastern Atlantic and Indo-West Pacific.

Mimachlamys albolineata (G. B. Sowerby 2nd, 1842)
(Plate 8, figs. 1-3)

Pecten albolineatus G. B. Sowerby 2nd, 1842: 73, pl. 14, f. 69, 70. *Mimachlamys albolineata* (Sowerby). Dijkstra, 1991: 33 [references].

Type material: Three possible syntypes BMNH, not registered.

Type locality: Guimaras Island, Philippines.

Material examined: The possible type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 27, Laing Island (Madang prov.), N reef flat, low tide, underside coral boulders, leg. J. Van Goethem, 18.V.1979, 1 live specimen, IG 26.080; PNG 1979: 75, Laing Island, E-side reef flat, low tide, underside coral boulders, leg. J. Van Goethem, 23.V.1979, 1 live specimen, IG 26.080; PNG 1979: 112, Laing Island, N reef flat, low tide, underside coral boulders, leg. J. Van Goethem, 26.V.1979, 1 live specimen, IG 26.080; PNG 1980: 2, Nagada (N of Madang), Rash reef, dredged, 25 m, leg. J. Pierret, 29.VIII.1979, 1 valve, IG 26.086; PNG 1981: 400, Tobinam Point, reef flat, low tide, under coral boulders, leg. J. Van Goethem et al., 29.VI.1981, 1 live specimen, IG 26.373; PNG 1981: 466, Chirimosh Island, reef flat, low tide, underside coral boulders in intertidal zone, leg. J. Van Goethem et al., 2 live specimens, IG 26.373; PNG 1981: 475, Ulingan harbour, E-side, small reef flat inside bay, very low tide, leg. J. Van Goethem and M. Magap, 16.VII.1981, 1 specimen, IG 26.373.

Distribution: Throughout the Indo-West Pacific and northeastern Indian Ocean. Living byssally attached to corals or amongst coral rubble on sand or mud in the littoral.

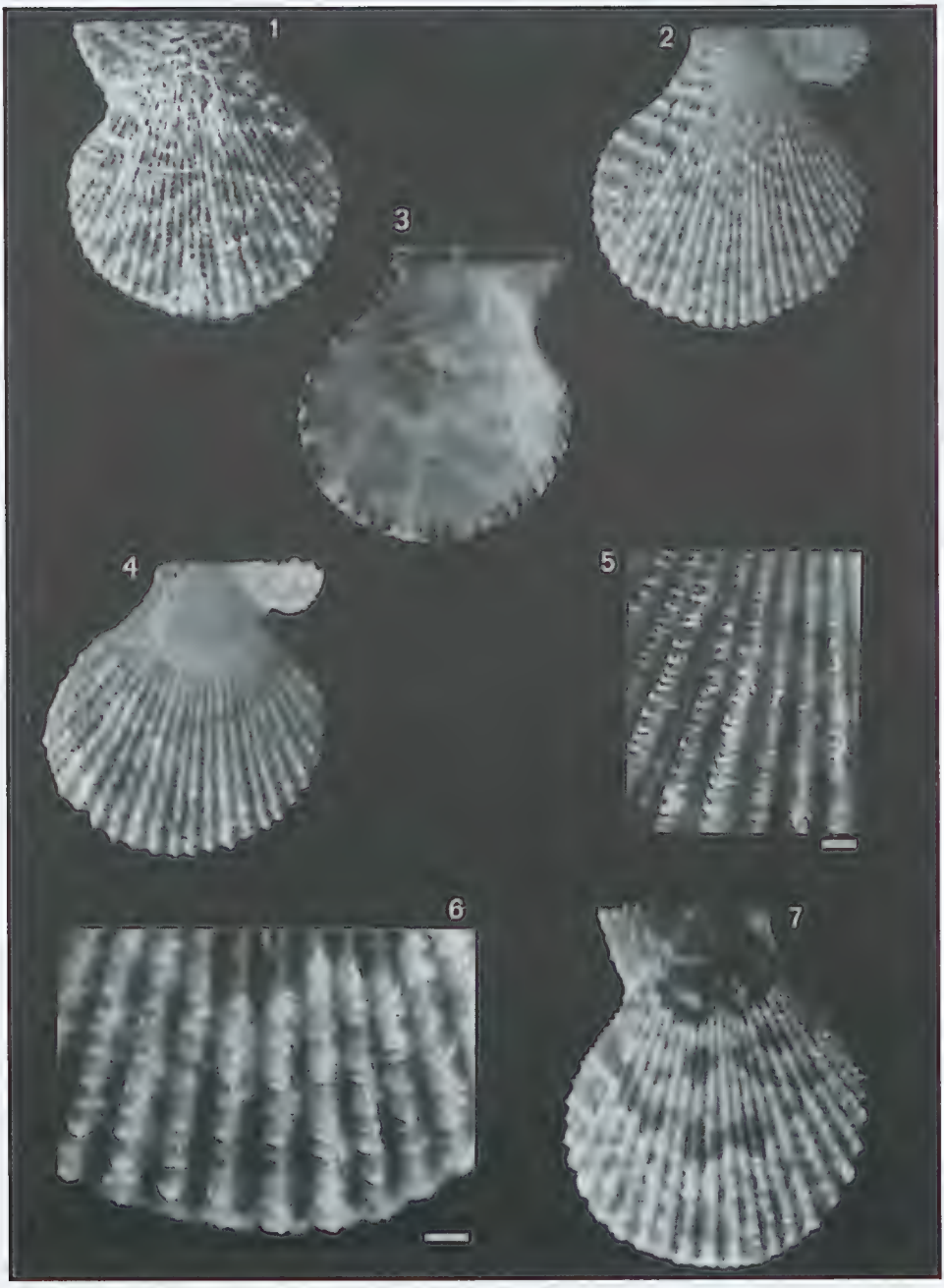


Plate 8.
Figures 1-3. *Mimachlamys albolineata* (Sowerby, 1842). KBIN, Ulingan harbour, H 18.1 mm, db. 1. Left valve, exterior. 2. Right valve, exterior. 3. Left valve, interior. **4-5.** *Mimachlamys cloacata* (Reeve, 1853). KBIN, Laing Island, 25-30 m, H 18.0 mm, rv. 4. Right valve, exterior. 5. Right valve, exterior, postero-marginal section (scale bar 1 mm). **6-7.** *Mimachlamys lentiginosa* (Reeve, 1853). KBIN, W Laing Island, 18-20 m, H 21.9 mm, lv. 6. Left valve, exterior, ventral marginal section (scale bar 1 mm). 7. Left valve, exterior.

Mimachlamys cloacata (Reeve, 1853)
(Plate 8, figs. 4-5)

Pecten cloacatus Reeve, 1853: sp. 166, pl. 34, f. 166.
Chlamys cloacata (Reeve). Dijkstra, 1991: 29 [synonymy, references, discussion].

Type material: Lectotype (H 27.0, L 24.5, D 11.2 mm) BMNH 1995158.1, and paralectotype BMNH 1995158.2 here designated.

Type locality: Philippines.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 9, Nagada, 20 m, leg. J. Pierret, 1.ix.1979, 1 valve, IG 26.086; PNG 1980: 24, Laing Island, 35 m, leg. J. Pierret, 22.viii.1980, 1 valve, IG 26.253; PNG 1980: 44, Laing Island, 25-30 m, leg. J. Pierret, 25.ix.1980, 1 valve, IG 26.253.

Distribution: Throughout the western and southwestern Pacific. Living amongst rubble and seaweeds on sand or muddy sand sediments at littoral to sublittoral depths.

Remarks: The present specimens are similar to the type material, although smaller of size (c. 20 mm) with a few more radial costae (20 ribs, typical 18). Intermediate variations are also observed with 16 to 22 ribs (HD, NNM, ZMA) from the Philippines and Indonesia. Live material was not collected from the Hansa Bay.

Mimachlamys lentiginosa (Reeve, 1853)
(Plate 8, figs. 6-7)

Pecten lentiginosus Reeve, 1853: sp. 76, pl. 20, f. 76.
Mimachlamys lentiginosa (Reeve). Dijkstra, 1991: 33 [synonymy, references, discussion].

Type material: Three syntypes BMNH 1950.11.14.40-42.

Type locality: Ticao Island, Philippines, under stones at low water.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 258, Laing Island, W-side, hand-dredged, 18-20 m, leg. D. Christensen, 6.VI.1979, 1 valve, IG 26.080.

Distribution: Throughout the Indo-West Pacific. Living byssally attached to rocks or corals on sandy or muddy sand sediments in the littoral.

Remarks: The present specimen is similar to the type material, although paler in colour. Juveniles of *M. lentiginosa* could easily be confused with *M. albolineata*. The latter species has a few more radial costae, lacks the red spot on the

umbonal top and is more whitish inside and dark-brown to black near the dorsal and ventral margins.

Mimachlamys senatoria (Gmelin, 1791)

Ostrea senatoria Gmelin, 1791: 3327 (based on Chemnitz, 1784: 320, pl. 65, f. 617). *Mimachlamys senatoria* (Gmelin). Dijkstra & Marshall, 1997: 101 [synonymy, references, type data].

Type material: Lectotype ZMUC BIV-45, designated by Dijkstra & Marshall (1997: 102).

Type locality: "Oceano indico" [= Indian Ocean].

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 9, Nagada (N of Madang), Tab reef, sand, dredged, 20 m, leg. J. Pierret, 1.IX.1979, 1 live specimen, IG 26.086; PNG 1979: 326, Nubia village, diving, hand-dredged, 10-12 m, leg. J. Pierret, 15.VI.1979, 1 live specimen, IG 26.080.

Distribution: Throughout the Indo-Pacific. Living byssally attached to rocks, corals, or amongst coral rubble on sandy or muddy sand sediments in the littoral.

Tribe **AEQUIPECTININI** Nordsieck, 1969
Genus **Cryptopecten** Dall, Bartsch & Rehder, 1938

Cryptopecten Dall, Bartsch & Rehder, 1938: 93.
Type species (by original designation): *Cryptopecten alli* Dall, Bartsch & Rehder, 1938 [= *Pecten (Chlamys) bullatus* Dautzenberg & Bavay, 1912]. Miocene-Recent. Indo-West Pacific (Hayami, 1989: 15).

Cryptopecten nux (Reeve, 1853)

Pecten coruscans Hinds. Reeve, 1853: text unpag., pl. 32, f. 143 (see errata) (not Hinds, 1845).
Pecten nux Reeve, 1853: see errata.
Cryptopecten nux (Reeve). Dijkstra & Marshall, 1997b: 107 [synonymy, references, type data, discussion].

Type material: Lectotype BMNH 1950.11.14.50, designated by Wagner (1989: 53, f. 6-7).

Type locality: Panglas, Bohol, Philippines; designated by Wagner (1989).

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1976, Duangit 9 + 10, leg. J. Bouillon et al., 1976, 1 valve, IG 25.715; PNG

1976: H3, Awar, trawled, 21 m, leg. B. Tursch and J. Pierret, 1976, 1 live specimen, IG 26.132; PNG 1976, NW Duangit, trawled, 60-65 m, leg. B. Tursch and J. Pierret, 1976, 2 live specimens, IG 26.132; PNG 1976, SE Duangit, trawled, 60 m, leg. B. Tursch and J. Pierret, 1976, 1 valve, IG 26.132; PNG 1976, E Duangit, trawled, 24-63 m, leg. B. Tursch and J. Pierret, 1976, 2 live specimens, IG 26.132; PNG 1976, Duangit, leg. B. Tursch and J. Pierret, 30.viii.1976, 1 live specimen, IG 26.132; PNG 1977, Laing Island, Duangit reef, 45 m, leg. B. Tursch and J. Pierret, 1977, many valves, IG 25.930; PNG 1978, N Duangit (20), dredged, 45-60 m, leg. B. Tursch, 1978, many valves, IG 25.955; PNG 1979, N Duangit (31), dredged, 45-60 m, leg. B. Tursch, 1978, 2 specimens, IG 25.955; PNG 1979: 12, leg. B. Tursch, 1978, 1 specimen, IG 25.955; PNG 1979: 18, Nagada (N of Madang), Wongat reef, dredged, 25-30 m, leg. J. Pierret, 6.ix.1979, 1 valve, IG 26.086; PNG 1979: 58, NE-end of Laing Island (Madang prov.), coral sand, hand-dredged, 30-35 m, leg. J. Pierret, 21.v.1979, 1 live specimen, IG 26.080; PNG 1980: C1, Laing Island, dredged, 30 m, leg. J. Pierret, 29.v.1980, 1 valve, IG 26.253; PNG 1980: H1, Laing Island, dredged, 12-15 m, leg. J. Bouillon, 20.xii.1980, 1 valve, IG 26.370; PNG 1980: 29, Laing Island J2, sand, coral rubble, dredged, 30-35 m, leg. J. Pierret, 6.ix.1980, 1 live specimen, IG 26.253; PNG 1980: 32, Mililat (N of Madang), barrier reef, hand-dredged, 10-18 m, leg. J. Pierret, 25.ii.1980, 1 specimen, IG 26.080; PNG 1980: 62, Potsdam PL, dredged, 35-52 m, leg. J. Pierret, 24.x.1980, 1 specimen, IG 26.253; PNG 1980: 87, Hansa Bay, SE Duangit, dredged, 50-52 m, leg. J. Pierret, 1980, 1 valve, IG 26.227; PNG 1980: 117, Duangit reef, E-side, hand-dredged, 40-46 m, leg. J. Pierret, 27.v.1980, 1 valve, IG 26.080; PNG 1980: 419, Duangit reef, E-side, diving, hand-dredged, 48 m, leg. J. Pierret, 23.vi.1980, several valves, IG 26.080; PNG 1981: 36, SE Duangit, dredged, 52 m, leg. J. Pierret, 17.ix.1980, 1 specimen, IG 26.253; PNG 1981: 39, E Duangit, leg. J. Pierret, 21.ix.1980, 1 specimen, IG 26.253; PNG 1981: 40, E Duangit, dredged, 50 m, leg. J. Pierret, 22.ix.1980, 1 valve, IG 26.253; PNG 1981: 52, Wanginem reef 2, dredged, 40 m, leg. J. Pierret, 11.x.1980, 1 specimen, IG 26.253; PNG 1981: 61, SE Wanginem 2, dredged, 40 m, leg. J. Pierret, 23.x.1980, 1 valve, IG 26.253; PNG 1981: 70, NE Duangit, dredged, 50-52 m, leg. J. Pierret, 30.x.1980, 1 valve, IG 26.253; PNG 1981: 77, SE Laing Island, dredged, 45 m, leg. J. Pierret, 21.xi.1980, 2 valves, IG 26.227; PNG 1981, SE Duangit, dredged, 50 m, leg. J. Pierret, 21.xi.1980, 1 specimen, IG 26.227; PNG 1981: 83, NE Duangit, dredged, 50 m, leg. J. Pierret, 4.xii.1980, 2 valves, IG 26.227; PNG 1981: 85, NE Duangit, dredged, 50 m, leg. J. Pierret, 6.xii.1980, 1 valve, IG 26.227; PNG 1981: 89, NE Duangit, coral colonies, dredged, 40 m, leg. J. Pierret, 9.xii.1980, 2 valves, IG 26.227; PNG 1981: 181, Wanginem reef, coral sand with some mud, hand-dredged, 43 m, leg. J. Pierret, 28.v.1981, 2 live specimens + many valves, IG 26.373; PNG 1981: 189, NW Duangit reef, hand-dredged, 50 m, leg. J. Pierret, 29.v.1981, many valves, IG 26.373; PNG 1981: 233, NE Duangit reef, hand-dredged, 45-50 m, leg. J. Pierret, 3.vi.1981, 1 specimen, IG 26.373; PNG 1981: 392, hand-dredged, 57 m, leg. J. Pierret, 28.vi.1981, 1 valve, IG 26.373; Laing Island, 1 live specimen, ex Tursch coll. (HD); off Awar strip, dredged, 75 m, 5 live specimens, ex Tursch coll. (HD).

Distribution: Throughout the Indo-Pacific. Living amongst coral rubble or in muddy or sandy sediments at littoral to bathyal depths.

Genus **Haumea** Dall, Bartsch & Rehder, 1938

Haumea Dall, Bartsch & Rehder, 1938: 86.
Type species (by original designation): *Haumea juddi* Dall, Bartsch & Rehder, 1938 [= *Pecten loxoides* G. B. Sowerby 2nd, 1882]. Recent. Indo-West Pacific.

Haumea rehderi (Grau, 1960)
(Plate 9, figs. 1-4)

Chlamys (Argopecten) rehderi Grau, 1960: 15, pl. 2, f. 1-3.
Pecten (Aequipecten) aequisulcatus Carpenter. Dautzenberg & Bavay, 1912: 19 (not *P. aequisulcatus* Carpenter, 1864).
Argopecten rehderi (Grau). Dijkstra, 1988: 3, figs. ;1989: 2, 12, figs.
Chlamys (Argopecten) rehderi Grau. Dijkstra, 1990: 11, pl. 2, f. 16-17.

Type material: Holotype USNM 612201.

Type locality: Tereia Point, Bora Bora Island, Leeward Group, Society Islands, French Polynesia.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1976: 206, W of Laing Island, dredged, 30 m, leg. J. Pierret, 29.iii.1976, 1 valve, IG 25.485; PNG 1981: 197, dredged, 36 m, leg. B. Tursch and J. Pierret, 1981, 1 valve, IG 26.132; Laing Island, 1 specimen, ex Tursch coll. (HD).

Distribution: Known from the southwestern Pacific to French Polynesia. Living amongst coral rubble in muddy sand or sand sediments in the littoral.

Remarks: The present specimens are similar to the type material, although the types are more colourful. The specimens from the Hansa Bay are more uniform red or yellow. Juveniles could be easily confused with small specimens of *C. nux*, but the latter species has more complicated radial costae with hollow sections. *H. rehderi* has massive rounded radial costae with fine concentric lamellae. Species of *Argopecten* are not known from the Indo-Pacific region.

Genus **Volachlamys** Iredale, 1939

Volachlamys Iredale, 1939: 356.
Type species (by original designation): *Pecten cumingii* Reeve, 1853. Miocene?-Recent. Yellow Sea and Indo-West Pacific (Hayami, 1989: 16).

Volachlamys singaporina (G. B. Sowerby 2nd, 1842)
(Plate 9, fig. 5)

Pecten singaporinus G. B. Sowerby 2nd, 1842: 74, pl. 13, f. 55, pl. 14, f. 71.
Volachlamys singaporina (Sowerby). Dijkstra & Kastoro, 1997: 276 [synonymy, references, type data, description, discussion].

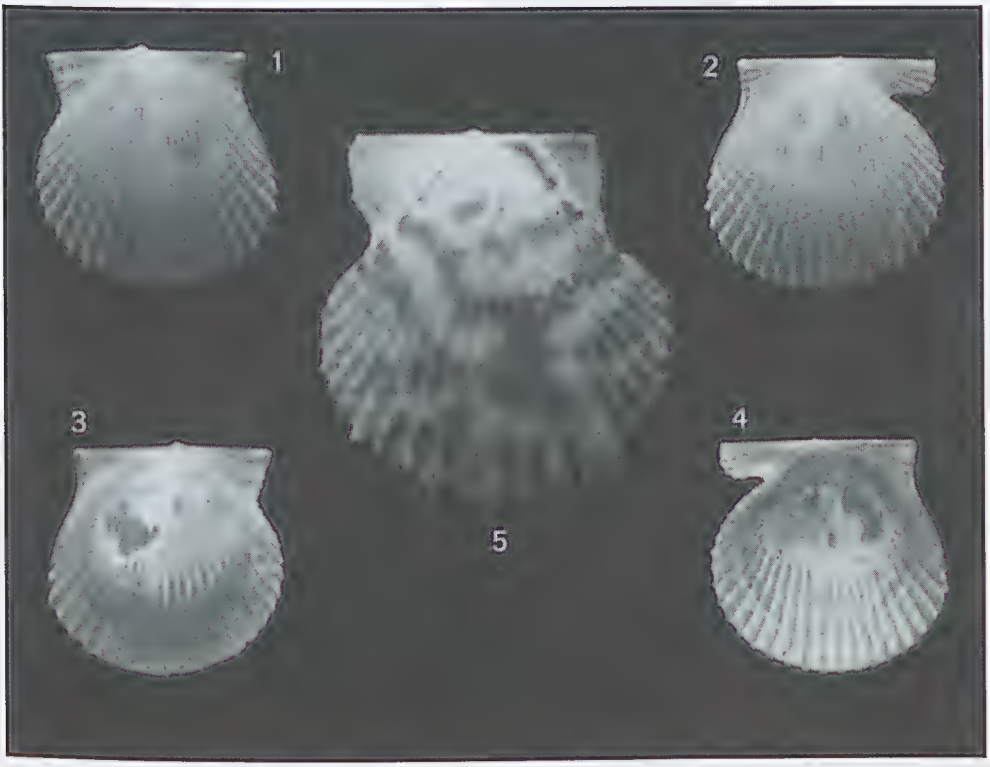


Plate 9.
Figures 1-4. *Haumea rehderi* (Grau, 1960). HD, Hansa Bay, W-1, 45m, H 6.1 mm, db. 1. Left valve, exterior. 2. Right valve, exterior. 3. Left valve, interior. 4. Right valve, interior. 5. *Volachlamys singaporina* (Sowerby, 1842). KBIN, between Awar Point and Condor Point, intertidal, H 21.1 mm, lv.

Type material: Lectotype BMNH 1994127/1, 2 paralectotypes BMNH 1994127/2-3, designated by Dijkstra & Kastoro (1997a: 279).

Type locality: Singapore.

Material examined: The type material. HANSA BAY, PAPUA NEW GUINEA: PNG 1979: 319, reef flat between Awar Point and Condor Point, leg. J. Van Goethem, 14.vi.1979, 1 valve, IG 26.080.

Distribution: Throughout the southwestern Pacific to northern Australia. Living byssally attached under rocks, coral boulders or amongst coral rubble on muddy, muddy sand or sandy sediments in the littoral.

Remarks: The present specimen is similar to the type material. Material examined from Indonesia and Australia (AMS, HD, MNHN, NNM, WAM, ZMA) are variable in radial costae (18 to 22). It is possible that *Volachlamys cumingi* (Reeve, 1853) from Queensland is only a geographic form. Material examined from that region usually has fewer radial costae, but otherwise shell characters are similar to *V. singaporina*.

Acknowledgements

I am most grateful to Dr J. Van Goethem (KBIN) for making the Hansa Bay pectinoid material available for study, and to Mr A. Lievrouw (KBIN) for assistance during my visit to the KBIN. Also many thanks are due to Prof. B. Tursch at Brussels for allowing me to study his private pectinoid collection, and to Dr T. Backeljau (KBIN) for assistance and advice in many ways. Sincere thanks are also due to several staff members of the following institutions for allowing me to study the type and systematic collections, for loaning type material, or for further advice and information and to private collectors, who donated me pectinid material for taxonomic research: Dr W. Ponder and Mr I. Loch (AMS), Mrs S. Morris (formerly curator of the Mollusca of the LSL), Ms K. Way and Mrs J. Mulrooney (BMNH), Drs C. Vaucher and Y. Finet (MHNG), Drs P. Bouchet and B. Métivier (MNHN), the late Dr E. Wawra and Dr H. Sattmann (NHMW), Prof Dr E. Gittenberger and Mr J. Goud (NNM), Dr J. Stanisic (QM), Dr K. Schniebs (SMTD), Dr R. C. Preece (UMZC), Dr T. R. Waller (USNM), Dr L. Wallin (UUZM), Dr F. Wells and Mrs S. Slack-Smith (WAM), Mr R. G. Moolenbeek (ZMA), Dr J. Knudsen and Mr T. Schiøtte (ZMUC), Drs N. V. Subba Rao and K. V. Surya Rao (ZSI), Mr P. Crandall at Okinawa (Japan), and Mr T. C. Lan at Taipei (Taiwan). Many thanks are also due to Ms I. Bachy and Mr J. Cillis (KBIN) for preparing monochrome photographs and SEM-micrographs.

References

Abbott, R. T. 1954. American seashells. Van Nostrand, New York.

Abbott, R. T. & Dance, S. P. 1982. Compendium of seashells. Dutton, New York.

Adams, A. & Reeve, L. A. 1850. Mollusca. in: *'The zoology of the voyage of the H. M. S. Samarang'*. Adams, A. (ed.). Reeve, Benham and Reeve, London, pp. 1-87.

Anton, H. E. [1838]. Verzeichniss der Conchylien welche sich in der Sammlung von Hermann Eduard Anton befinden. Anton, Halle.

Bavay, A. 1903. Note sur quelques espèces du genre *Pecten*, nouvelles ou mal connues. *Journal de Conchyliologie* **50:** 399-406.

Bavay, A. 1904. Note au sujet des chantillons non déterminés du *Pecten* communiqués par le Musée d'Amsterdam. *Bulletin du Muséum d'Histoire Naturelle, Paris,* **1904 (6):** 364.

Bernard, F. R., Cai, Y. Y. & Morton, B. 1993. Catalogue of the living marine bivalve molluscs of China. Hong Kong University Press, Hong Kong.

Born, I. 1778. Index Rerum Naturalium Musei Caesarei Vindobonensis. Pars I. Testacea. Kraus, Vienna.

Born, I. 1780. Testacea Musei Caesarei Vindobonensis. Kraus, Vienna.

Boss, K.J. 1982. Classification of Mollusca. in: *'Synopsis and Classification of Living Organisms.'* Vol. 2. Parker, S. P. (ed.). New York. pp 1092-1096.

Bouillon, J., Claereboudt, M. & Seghers, G. 1986. Hydroméduses de la baie de Hansa (Mer de Bismarck; Papouasie Nouvelle-Guinée). Répartition, conditions climatiques et hydrologiques. *Indo-Malayan Zoology* **3:** 105-152.

Bronn, H. G. 1832. Ergebnisse meiner naturhistorisch-öconomischen Reisen. 2. Skizzen und Ausarbeitungen über Italien nach einem zweyten Besuche im Jahre 1827. Heidelberg, Leipzig.

Carpenter, P. P. 1864. Supplemantary report on the present state of our knowledge with regard to the Mollusca of the west coast of North America. *Report of the 26th Meeting British Association for the Advancement of Science 1863,* **33:** 517-686.

Chemnitz, J. H. 1784. Neues systematisches Conchylien-Cabinet, 7. Raspe, Nuremberg.
Chenu, J. C. 1842-1853. Illustrations Conchyliologiques ou Description et Figures de toutes les Coquilles connues Vivants et Fossiles, Classées Suivant le Système de Lamarck. Franck, Paris.
Claereboudt, M. & Bouillon, J. 1987. Coral associations, distribution and diversity on Laing Island reef (Papua New Guinea). *Indo-Malayan Zoology* **4:** 11-25.
Crandall, P. R. 1979. A new cone from off NE Taiwan and a new *Chlamys* from the Ryukyu Islands, Japan. *Quarterly Journal of Taiwan Museum* **32:** 113-115.
Da Costa, E. M. 1778. Historia naturalis testaceorum Britanniae, or, The British Conchology. White, Elmsley and Robson, London.
Dall, W. H., Bartsch, P. & Rehder, H. A. 1938. A manual of the recent and fossil marine pelecypod mollusks of the Hawaiian Islands. *Bernice P. Bishop Museum Bulletin* **153:** 1-233.
Dautzenberg, P. & Bavay, A. 1912. Les lamellibranches de l'expédition du 'Siboga'. Systématique. I. Pectinidés. *Siboga Expeditie Mon.* **53b:** 1-41.
Defrance, M. J. L. 1825. Peigne. in: *Dictionnaire des Sciences Naturelle* **38:** 251-267.
Deshayes, G. P. 1830. Coquilles de la Mer Rouge: 66. In: Laborde, L. E. S. J. de and Linant, 1830-1834, Voyage de l'Arabie Pétrée. Giard, Paris.
Deshayes, G. P. 1832. Encyclopédie Méthodique. Histoire Naturelle des Vers, vol. 3. Agasse, Paris.
Deshayes, G. P. 1863. Catalogue des mollusques de l'île de la Réunion (Bourbon). Annexes E. in: Maillard, L., Notes sur l'Île de la Réunion (Bourbon). Dentu, Paris.
Dijkstra, H. H. 1983-1989. Rare or poorly known pectinids. *La Conchiglia /The Shell* **15-21** [10 parts].
Dijkstra, H. H. 1983-1994. Les Pectinidae de N. Calédonie / The Pectinidae of New Caledonia. *Rossiniana* **21-60** [35 parts].
Dijkstra, H. H. 1988. Two new pectinids from the Philippines (Bivalvia: Pectinidae). *La Conchiglia / The Shell* **20 (236-237):** 16-18.
Dijkstra, H. H. 1989. Les Pectinidae de Polynésie Française (exposé préliminaire) / Pectinidae from French Polynesia (a preliminary report). *Xenophora* **48:** 11-19.
Dijkstra, H. H. 1990. Three new Pectinacean species from the Indonesian archipelago collected during the 'Siboga' expedition (1899-1900) with additional information and corrections on the previous report (Mollusca: Propeamussiidae, Pectinidae). *Beaufortia* **40:** 1-14.
Dijkstra, H. H. 1991. A contribution to the knowledge of the pectinacean Mollusca (Bivalvia: Propeamussiidae, Entoliidae, Pectinidae) from the Indonesian Archipelago. *Zoologische Verhandelingen, Leiden* **271:** 1-57.
Dijkstra, H. H. 1994. Type specimens of recent species of Pectinidae described by Lamarck (1819), preserved in the Muséum d'Histoire Naturelle of Geneva and the Muséum National d'Histoire Naturelle of Paris. *Revue suisse de Zoologie* **101(2):** 465-532.
Dijkstra, H. H., 1995a. Notes on taxonomy and nomenclature of Pectinidae (Mollusca: Bivalvia). 1. *Anguipecten picturatus* nom. nov. *Basteria* **59:** 15-19.
Dijkstra, H. H., 1995b. Bathyal Pectinoidea (Bivalvia: Propeamussiidae, Entoliidae, Pectinidae) from New Caledonia and adjacent areas. Pp. 9-73. in: Bouchet, P. (Ed.), 167 Résultats des Campagnes MUSORSTOM, vol. 14. Mémoires du Muséum national d'Histoire naturelle Paris,
Dijkstra, H. H. & Kastoro, W. W., 1997. Mollusca Bivalvia: Pectinoidea (Propeamussiidae and Pectinidae) from eastern Indonesia. Pp. 245-285. in: Crosnier, A. and Bouchet, P. (Eds.), 172. Résultats des Campagnes MUSORSTOM, vol. 16. Mémoires du Muséum national d'Histoire naturelle.

Dijkstra, H. H. & Marshall, B. A., 1997b. Pectinoidea (Mollusca: Bivalvia: Propeamussiidae: Pectinidae) of Lord Howe Island, Norfolk Island and the Kermadec Islands. *Molluscan Research* **18:** 73-114.

Dijkstra, H. H., Richer de Forges, B., Clavier, J. & Lefort, Y. 1989-1990. Pectinides des fonds meublesdans les lagons de N. Calédonie et de Chesterfield / Pectinidae found on the soft bottoms of the New Caledonian and Chesterfield lagoons. *Rossiniana* **45-47** [3 parts].

Dunker, W. 1864. Fünf neue Mollusken. *Malakozoologische Blätter* **11:** 99-102.

Fischer, P. 1858. Notes pour servir à la fauna malacologique de l'archipel Calédonien. *Journal de Conchyliologie* **7:** 329-342.

Forsskål, P. 1775. Descriptiones animalium, avium, amphibiorum, piscium, insectorum, vermium; quae in itinere orientali observavit Petrus Forskål. Prof. Haun. Post mortem auctoris edidit Carsten Niebuhr. Copenhagen.

Gmelin, J. F. 1791. Caroli Linnaei systema naturae per regna tria naturae. Ed. 13, aucta, reformata, Vermes Testacea I (6). Beer, Leipzig.

Goldfuss, G. A. 1833. Petrefacta Germaniae. Abbildungen und Beschreibungen der Petrefacten Deutschlands, 2(4). Arnz, Dusseldorf.

Grau, G. 1959. Pectinidae of the eastern Pacific. *Allan Hancock Pacific Expeditions* **23:** i-viii, 1-308.

Grau, G. 1960. A new *Chlamys* from the south Pacific. *Nautilus* **74(1):** 15-18.

Gregorio, A. de 1884. Nota intorno ad alcune nuove Conchiglie mioceniche di Sicilia. *Naturalista Siciliano* **3:** 119-120.

Habe, T. 1951. Genera of Japanese shells. Pelecypoda, 1. *Kairui, Bunken* and *Kankokai*, Tokyo.

Habe, T. 1977. Systematics of Mollusca in Japan. Bivalvia and Scaphopoda. Hokuryu-kan, Tokyo.

Habe, T. 1981. A catalogue of molluscs of Wakayama Prefecture, the province of Kii. I. Bivalvia, Scaphopoda and Cephalopoda. Kyoto University, Publications of the Seto Marine Biological Laboratory, Special Publication Series 7(1).

Hayami, I. 1989. Outlook on the Post-Paleozoic Historical Biogeography of Pectinids in the Western Pacific Region. in: *'Current Aspects of Biogeography in West Pacific and East Asian Regions.'* Ohba, I., Hayami, I. and Mochizuki, K. (eds.). The University Museum, The University of Tokyo, Nature and Culture, 1. Tokyo, pp. 1-25.

Hertlein, L. G. 1935. Notes on the Pectinidae of Hawaii. *Nautilus* **49(1):** 27-29.

Hertlein, L. G. 1969. Family Pectinidae Rafinesque, 1815. in: *'Treatise on Invertebrate Paleontology.'* Moore, R. C. (ed.).Part N1, Mollusca 6, Bivalvia. Pp. N348-N373. Geological Society of America and University of Kansas Press, Boulder.

Hinds, R. B. 1844-1845. The zoology of the voyage of H. M. S. 'Sulphur', under the command of Capt. Sir E. Belcher... during the years 1836-42. Part 2 [Mollusca]. Smith and Elder, London.

Iredale, T. 1929. Mollusca from the continental shelf of eastern Australia. *Records of the Australian Museum* **17:** 157-189.

Iredale, T. 1939. Mollusca. Part I. Pp. 209-425. In: British Museum (Natural History) Great Barrier Reef Expedition 1928-29. Scientific Reports 5. British Museum (Natural History), London.

Kira, T. 1960. Coloured illustrations of the shells of Japan [in Japanese]. Hoikusha, Osaka.

Kleemann, K. 1990. Coral associations, biocorrosion, and space competition in *Pedum spondyloideum* (Gmelin) (Pectinacea, Bivalvia). *Marine Ecology* **11(1):** 77-94.

Kuroda, T. 1929-1935. An illustrated catalogue of the Japanese shells. Parts 1-16. *Venus*, separately paged appendices to vols. 1-5: 1-154.

Kuroda, T. & Habe, T. 1981. A catalogue of molluscs of Wakayama prefecture, the province of Kii. Part I. Bivalvia, Scaphopoda and Cephalopoda. *Publications of the Seto Marine Biological Laboratory, Special Publication Series* **7 (1):** 1-301.

Kuroda, T., Habe, T. & Oyama, K. 1971. The sea shells of Sagami Bay collected by His Majesty the Emperor of Japan. Maruzen, Tokyo.

Küster, H. C. & Kobelt, W. 1842-1888. Die Gattungen *Spondylus* und *Pecten*. Pp. 1-296. in: Systematisches Conchylien-Cabinet von Martini und Chemnitz, neu herausgegeben und vervollständigt von H. C. Küster. Band 7 (2). Bauer and Raspe, Nüremberg.

Lamarck, J. B. P. A. de M. de 1799. Prodrome d'une nouvelle classification des coquilles. *Mémoire de la Société Histoire naturelle, Paris* **1:** 63-91.

Lamarck, J. B. P. A. de M. de 1819. Histoire naturelle des animaux sans vertèbres 6 (1). Lamarck, Paris.

Lamy, E. 1928. Les peignes de la mer Rouge (d'après les matériaux recueillis par le Dr. Jousseaume). *Bulletin du Muséum National d'Histoire Naturelle, Paris* **34:** 166-172.

Lamy, E. 1935. Catalogue des Pectinidae vivants du Muséum National d'Histoire Naturelle de Paris déterminés par feu A. Bavay. *Journal de Conchyliologie* **79:** 306-321.

Linnaeus, C. 1758. Systema naturae per regna tria naturae. Ed. decima, reformata. Regnum animale I. Salvii, Stockholm.

Lynge, H. 1909. The Danish Expedition to Siam 1899-1900. IV. Marine Lamellibranchiata. Kongelige Danske Videnskabernes Selskabś Skrifter 7, Raekke, Naturvidensk og Mathem. Afd. V. 3. Copenhagen.

Müller, O. F. 1776. Zoologiae Danicae Prodomus, seu animalium Daniae et Norvegiae indigenarum characteres, nomina, et synonyma imprimis popularium. Copenhagen.

Nordsieck, F. Die europäischen Meeresmuscheln (Bivalvia). Gustav Fischer, Stuttgart.

Oliver, P. G. 1992. Bivalved Seashells of the Red Sea. Christa Hemmen, Wiesbaden and National Museum of Wales, Cardiff.

Perry, G. 1811. Conchology, or the Natural History of Shells; containing a new arrangement of the genera and species. Miller, London.

Petit de la Sausseye, M. S. 1853. Description d'une variété du *Pecten histrionicus* Gmel. *Journal de Conchyliologie* **4:** 150-152.

Philippi, R. A. 1842-1845. Abbildungen und Beschreibungen neuer oder wenig gekannter Conchylien, unter Mithülfe mehrerer Deutscher Conchyliologen I. Fischer, Cassel.

Preston, H. B. 1908. Descriptions of new species of land, marine and freshwater shells from the Andaman Islands. *Records of the Indian Museum* **2 (2):** 187-210.

Reeve, L. A. 1852-1853. Conchologia Iconica: or, Illustrations of the shells of Molluscous animals. Vol. 8. Monograph of the genus *Pecten*: text unpaged, pls. 1-35.

Röding, P. F. 1798-1799. Museum Boltenianum. Pars secunda, continens Conchylia sive Testacea univalvia, bivalvia et multivalvia. Christi, Hamburg.

Sacco, F. 1897a. I molluschi dei terreni terziarii del Piemonte e della Liguria. Part 23 (Ostreidae, Anomiidae e Dimyidae). *Bollettino dei Musei di zoologia e anatomia comparata della Reale Universita di Torino* **12:** 101-102.

Sacco, F. 1897b. I Molluschi dei terreni Terziarii del Piemonte e della Ligura. Part 24 (Pectinidae). Carlo Clausen, Torino.

Smith, E. A. 1885. Report on the Lamellibranchiata collected by H. M. S. 'Challenger' during the years 1873-1876. in: *Report on the scientific results of the voyage of H. M. S. 'Challenger' during the years 1873-1876. Zoology* **13 (35)**. London. pp. 1-341.

Smith, E. A. 1903. Marine mollusca, in: *'The fauna and geography of the Maldive and Laccadive archipelagoes II (2).'* Gardiner, J. S. (Ed.).Cambridge. pp. 589-630.
Souverbie, S. M. & Montrouzier, R. P. 1874. Descriptions d'espèces nouvelles de l'archipel Calédonien. *Journal de Conchyliologie* **22:** 200-201.
Sowerby, G. B. 2nd. 1839. A Conchological Manual. Sowerby, London.
Sowerby, G. B. 2nd. 1842. Monograph of the genus *Pecten.*, in: *'Thesaurus Conchyliorum, or figures and descriptions of recent shells 1 (2).'* Sowerby, London. pp. 45-82.
Sowerby, G. B. 2nd. 1882. Descriptions of new species of shells in the collection of Mr. J. Cosmo Melvill. *Proceedings of the Zoological Society of London* **1882:** 117-120.
Sowerby, J. & Sowerby, J. D. C. 1812-1828. The Mineral Conchology of Great Britain, 1-7. Sowerby, London.
Springsteen, F. J. & Leobrera, F. M. 1986. Shells of the Philippines. Carfel Seashell Museum. Manila.
Teppner, W. von 1922. Lamellibranchiata tertiaria. "*Anisomyaria* ". Pars 15. Pp. 67-296. In: Diener, C. (Ed.). Fossilium Catalogus, I: Animalia. W. Junk, Berlin.
Waller, T. R. 1972. The Pectinidae (Mollusca: Bivalvia) of Eniwetok Atoll, Marshall Islands. *Veliger* **14:** 221-264.
Waller, T. R. 1978. Morphology, morphoclines and a new classification of the Pteriomorphia (Mollusca: Bivalvia). *Philosophical Transactions of the Royal Society of London B* **284:** 345-365.
Waller, T. R. 1984. The ctenolium of scallop shells: functional morphology and evolution of a key family-level character in the Pectinacea (Mollusca: Bivalvia). *Malacologia* **25:** 203-219.
Waller, T. R. 1986. A new genus and species of scallop (Bivalvia: Pectinidae) from off Somalia, and the definition of a new tribe Decatopectinini. *Nautilus* **100:** 39-46.
Waller, T. R. 1991. Evolutionary relationship among commercial scallops (Mollusca: Bivalvia: Pectinidae), in: *'Scallops: biology, ecology and aquaculture.'* Shumway, S. E. (ed.). Elsevier, Amsterdam, Oxford, New York, Tokyo. Pp. 1-73.
Waller, T. R., 1993. The evolution of "*Chlamys* " (Mollusca: Bivalvia: Pectinidae) in the tropical western Atlantic and eastern Pacific. *American Malacological Bulletin* **10(2):** 195-249.
Wang, Z. 1989. Studies on the Chinese species of the family Pectinidae. VIII. Subfamily Pecteninae. *Studia Marina Sinica* **30:** 178-183.
Webb, J. H. 1957. New form of *Pecten. Nautilus* **71:** 53-54.
Wilkes, J. 1810. Conchology, in: *Encyclopaedia Londinensis; or, Universal Dictionary of Arts, Sciences, and Literature.* Adlard, London. pp. 14-41.
Yonge, C. M. 1967. Observations on *Pedum spondyloideum* (Chemnitz) Gmelin, a scallop associated with reef building corals. *Proceedings of the Malacological Society of London* **37:** 311-323.

Table 1:
Live and dead collected Pectinoidea from the Hansa Bay (PNG), with bathymetric range (S = in situ observed and/or collected); L = live collected; D = dead collected; ? = depth unknown)

Species	S	L	D
Propeamussiidae:			
1. *Parvamussium pauciliratum*	-	48-125	30-52
2. *Parvamussium scitulum*	-	60-125	48-52
Pectinidae:			
3. *Anguipecten picturatus*	-	-	40-45
4. *Anguipecten superbus*	-	?	?
5. *Bractechlamys oweni*	-	3-25	25-40
6. *Bractechlamys vexillum*	-	-	12-15
7. *Decatopecten radula*	-	2-30	-
8. *Excellichlamys spectabilis*	-	30	10-52
9. *Glorichlamys elegantissima*	-	-	30-35
10. *Gloripallium pallium*	-	20-25	3-45
11. *Juxtamusium coudeini*	-	20-35	5-25
12. *Juxtamusium maldivense*	-	25-30	-
13. *Mirapecten mirificus*	-	-	25-57
14. *Mirapecten rastellum*	-	58	5-50
15. *Minnivola pyxidata*	-	-	40
16. *Serratovola pallula*	-	60	-
17. *Serratovola passerina*	-	-	45-65
18. *Coralichlamys madreporarum*	?	?	
19. *Laevichlamys andamanica*	-	-	10
20. *Laevichlamys irregularis*	-	3-25	5-52
21. *Laevichlamys mollita*	-	?	-
22. *Laevichlamys squamosa*	-	3-30	5-25
23. *Pedum spondyloideum*	?	?	-
24. *Semipallium barnetti*	-	20-30	20-43
25. *Semipallium dianae*	-	?	-
26. *Semipallium fulvicostatum*	-	10	20-40
27. *Semipallium tigris*	-	3-5	3- 5
28. *Mimachlamys albolineata*	-	0-3	25
29. *Mimachlamys cloacata*	-	60	20-40
30. *Mimachlamys lentiginosa*	-	-	18-20
31. *Mimachlamys senatoria*	-	10-20	-
32. *Cryptopecten nux*	-	21-75	12-60
33. *Haumea inaequivalvis*	-	5-43	10-45
34. *Haumea rehderi*	-	45	30-45
35.*Volachlamys singaporina*	-	-	?
Total	2	26	27

Molluscan Research 19(1): 53-58 *(1998)*

A new monoplacophoran (Mollusca) from southern New Zealand

Bruce A. Marshall

Museum of New Zealand Te Papa Tongarewa
P.O. Box 467, Wellington, New Zealand

Abstract

Micropilina rakiura n.sp. is described from southern New Zealand, the second monoplacophoran known from the western Pacific. One specimen appears to have been parasitised by a boring foraminiferan, a new record for the Monoplacophora.

Key words: Mollusca, Monoplacophora, *Micropilina*, new species, Foraminifera, parasite, New Zealand.

Introduction

A new species of monoplacophoran, described herein, is the second Recent member of the class to have been found in the New Zealand region. The only other Recent monoplacophoran known from the entire western Pacific is *Micropilina tangaroa* Marshall, 1990, based on a single shell from the northern Three Kings Rise, northern New Zealand (Marshall, 1990). The present species brings to 24 the number of recorded Recent monoplacophorans (Warén &Gofas, 1997). The material is housed at the Museum of New Zealand Te Papa Tongarewa, Wellington (NMNZ).

Systematics

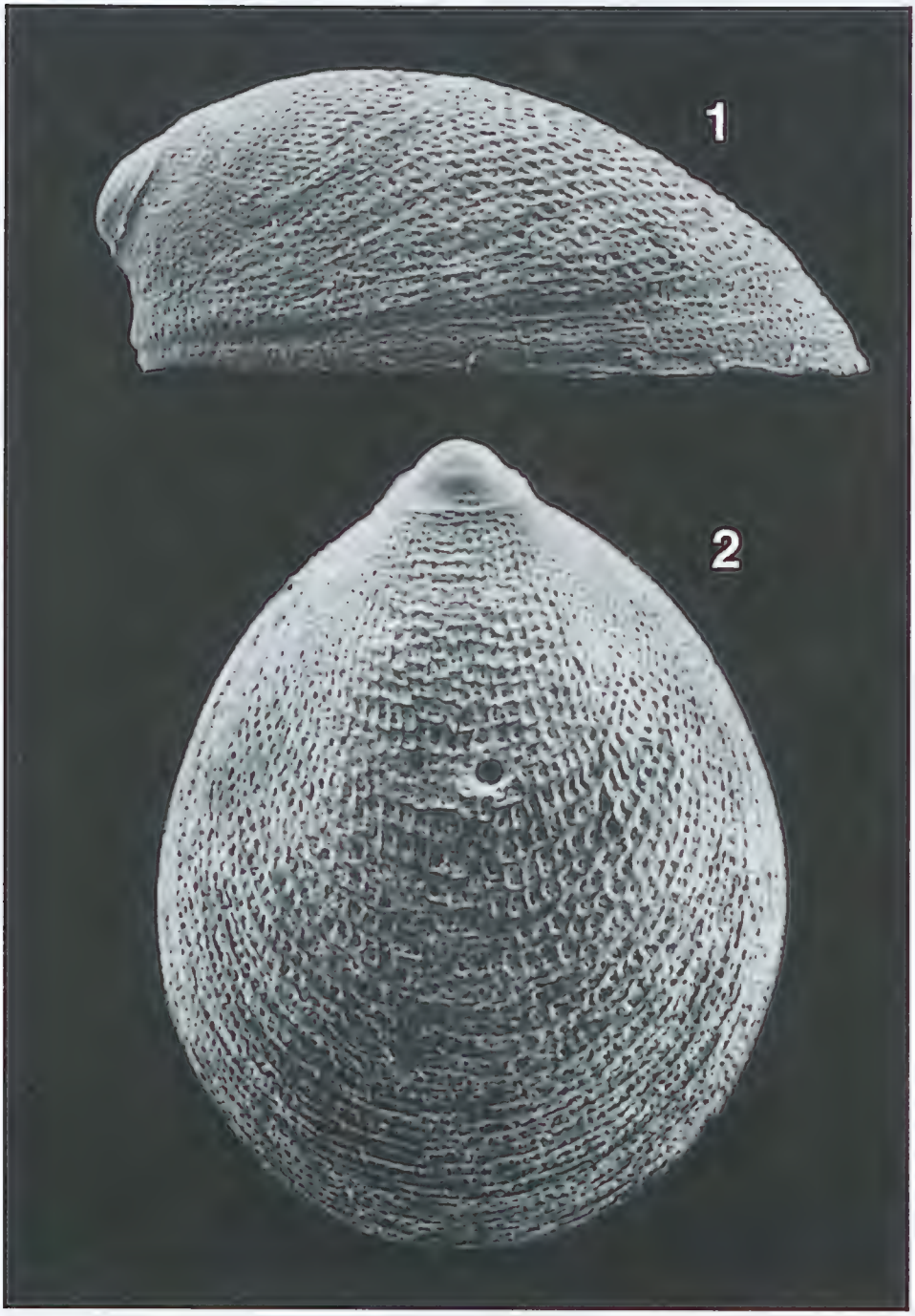
Family **MICROPILINIDAE** Haszprunar & Schaefer, 1997
Genus **Micropilina** Warén, 1989

Micropilina Warén, 1989: 2.
Type species (by original designation): *Micropilina minuta* Warén, 1989; Recent, northern Atlantic.

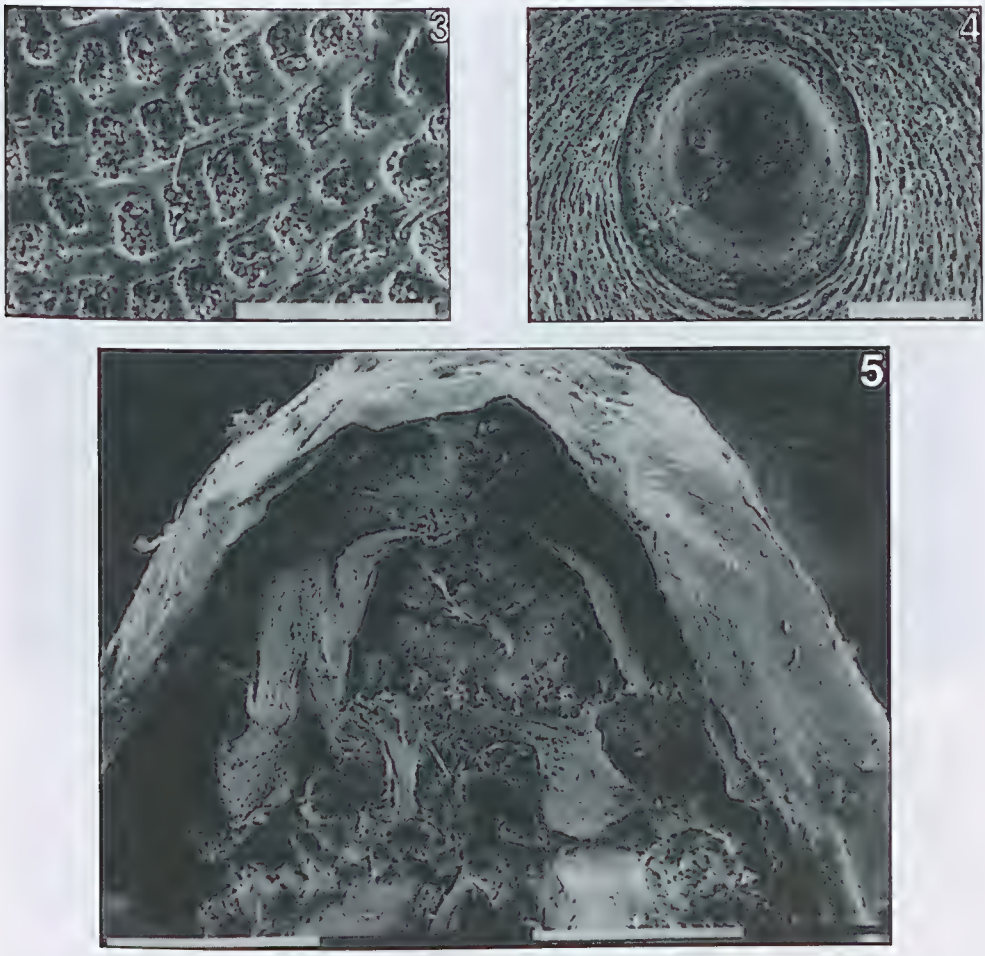
Remarks: Micropilina anatomy has been described by Haszprunar & Schaefer (1997a,b) who (1997b) transfered *Micropilina* from Neopilinidae to a new family, Micropilinidae. The family-group classifications proposed by Moskalev *et al.* (1983) and Starobogatov & Moskalev (1987) are considered to be too finely split (Warén & Bouchet, 1990; Warén & Hain, 1992; Warén & Gofas, 1997).

Micropilina rakiura n. sp.
(Figures 1-9)

Description: Shell (Figs 1-4) up to 1.25 mm long, thin, fragile, strongly arched capuliform; apertural margin ovate, posterior margin more broadly rounded

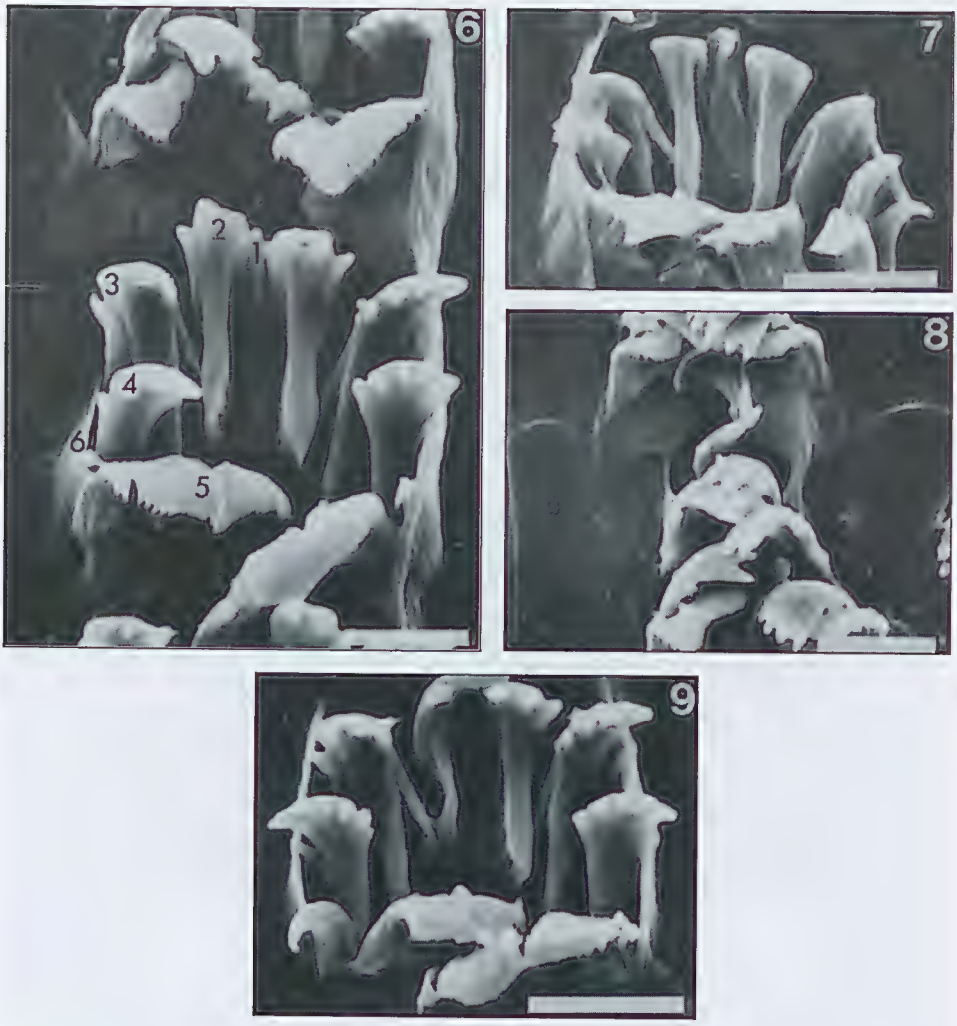


Figures 1, 2.
Micropilina rakiura: side (1) and dorsal (2) views of shell of holotype of (1.20 x 0.95 mm). The hole in the shell (Figure 2) was revealed after removal of an attached living foraminiferan.



Figures 3 - 5.
Micropilina rakiura.. **3.** Detail of teleoconch sculpture on dorsal surface at about mid shell length of holotype. **4.** Plan view of apical area of holotype. **5.** Oral area of critical point dried animal of paratype (NMNZ M.118896) (all animals partly dehydrated during freezer storage prior to receipt). Scales = 100 μm.

than anterior, profile concave from side to side; rounded apex projecting slightly beyond anterior apertural margin, translucent, colourless, no hexagonal prismatic structure. Apical area convex, 230 μm long, defined by sharp ridge, essentially smooth. Outside of apical area sculptured with fine, crisp, irregularly dislocated, similar, concentric and radial threads that enclose roundly quadrate spaces, interspaces wider than each thread. Interior smooth, polished. Animal (Fig. 5) poorly preserved. Radula (Figs 6-9) with 11 teeth per transverse row (consecutively numbered outwards). Central tooth long and narrow, thickened shaft face tapered to curved terminal cusp, hooded behind, edges of shaft face laterally flanged to interlock with adjacent teeth. Teeth 2-4 similar, long, stronger than central tooth, respectively with 3, 5 and 6 stout conical cusps, shafts laterally flanged and grooved to interlock with adjacent teeth. Tooth 5 broad,



Figures 6 - 9.
Micropilina rakiura, details of radula of holotype. Individual tooth elements numbered 1 - 6. Note worn tips on teeth 2 and 3 in Figure 7. Scales = 10 μm.

distal half deeply divided and fan-like with 20-25 long slender cusps. Tooth 6 about as long as inner teeth, subrectangular, thin in section, tip bluntly rounded.

Type data: Holotype (M.131609: length 1.20 mm, width 0.95 mm, height 0.47 mm) and 5 paratypes (M.118896) Museum of New Zealand, Wellington: 47°18.17'S, 165°49.9'E, "Mount Duncan", Puysegur Bank, south of Puysegur Point, Southland, New Zealand, living on clump of dead, manganese encrusted, branching coral (*Goniocorella* sp.), with a few, small attached living sponges and an octocoral, 896-1038 m, 16 October 1994, f.r.v. *Tangaroa* station 9409/78, M. Clark and D. Tracey.

Distribution: South of Puysegur Point, Southland, New Zealand, 896-1038 m (alive).

Remarks: Micropilina rakiura is the fourth known species of *Micropilina*: the others are *M. minuta* Warén, 1989 (Iceland, 770-926 m), *M. tangaroa* Marshall, 1990 (Three Kings Rise, northern New Zealand, 1216-1385 m), and *M. arntzi* Warén & Hain, 1992 (Lazarev Sea, Antarctica, 191-765 m). *M. rakiura* differs from *M. tangaroa* by having concentric riblets that are similar to the radials instead of much stronger, from *M. minuta* by having a much more openly reticulate sculpture, and from *M. arntzi* by having strong reticulate sculpture instead of much finer concentric sculpture. The radula of *M. rakiura* is similar to that of *M. arntzi*, but differs in the number of cusps on teeth 2-4 and in the shape and larger size of tooth 6. Regrettably all of the animals of *M. rakiura* had been dehydrated by prolonged freezing (received frozen), though what can be seen of the gross external anatomy resembles that in *M. arntzi* (Fig. 3, cf. Warén & Hain, 1992, fig. 17, 18).

The specimens of *M. rakiura* were sorted from residue washed from a block of dead, manganese encrusted coral (*Goniocorella* sp.), and were undoubtedly living attached to the coral. The type specimens of *M. arntzi*, the only other species to have been taken alive, were attached to stones or sorted from residues from samples that included stones and megafauna. The diet of *Micropilina* species is unknown, though like species of *Laevipilina* McLean, 1979, which also live on hard substrata, they are probably detritivores (McLean, 1979; Warén & Bouchet, 1990; Urgorri & Troncoso, 1994).

The holotype had a live foraminiferan (width 380 μm) attached to the exterior of its dorsum, removal of which revealed a minute perforation in the monoplacophoran's shell (Fig. 2), suggesting parasitism. The identity of the foraminiferan (regrettably lost) is unknown, though it was not unlike *Hyrrokkin sarcophaga* Cedhagen, 1994, at least superficially. Cedhagen (1994) has reviewed parasitism and boring by foraminiferans.

Etymology: Rakiura is the Maori name for Stewart Island, which is adjacent to the type locality and has a southern connotation.

Acknowledgements

I am grateful to M. Clark and D. Tracey (Ministry of Agriculture and Fisheries, Wellington) for the coral that yielded the specimens. Special thanks to A. Warén (Swedish Museum of Natural History) for skillful preparation and micrographs of the very delicate radula, and for comments on the manuscript. Thanks to W. St. George (Institute of Geological and Nuclear Sciences, Lower Hutt) and R. Thompson (Victoria University, Wellington) for assistance with scanning electron microscopy, and to K. Reader (Victoria University) for critical point drying.

References

Cedhagen, T. 1994. Taxonomy and biology of *Hyrrokkin sarcophaga* gen. et sp. n., a parasitic foraminiferan (Rosalinidae). *Sarsia* **79:** 65-82.

Haszprunar, G. & Schaefer, K. 1997a. Monoplacophora, in: *'Microscopic Anatomy of Invertebrates' 6B Mollusc* 2. Chapter **4**, pp 415-457, Wiley-Liss.

Haszprunar, G. & Schaefer, K. 1997b. Anatomy and phylogenetic significance of *Micropilina arntzi* (Mollusca, Monoplacophora, Micropilinidae fam. nov.) *Acta Zoologica* **77:** 315-334.

McLean, J.H. 1979. A new monoplacophoran limpet from the continental shelf off southern California. *Contributions in Science, Natural History Museum of Los Angeles County* **307:** 1-19.

Marshall, B.A. 1990. *Micropilina tangaroa*, a new monoplacophoran (Mollusca) from northern New Zealand. *The Nautilus* **104:** 105-107.

Moskalev, L.I., Starobogatov, Y.I. & Filatova, Z.A. 1983. New data on the abyssal Monoplacophora from the Pacific and South Atlantic oceans. *Zoologeski Zhurnal* **112:** 981-996. [In Russian]

Starobogatov, Y.I. & Moskalev, L.I. 1987. Systematics of the Monoplacophora. in: *Molluscs, results and perspectives of investigation. Eighth meeting on investigation of molluscs*. Leningrad. [In Russian] pp 7 -11

Urgorri, V. & Troncoso, J.S. 1994. A second record of *Laevipilina rolani* Warén & Bouchet, 1990 (Mollusca: Monoplacophora) from the northwest of Spain. *Journal of Molluscan Studies* **60:** 157-63.

Warén, A. & Bouchet, P. 1990. *Laevipilina rolani*, a new monoplacophoran from off southwestern Europe. *Journal of Molluscan Studies* **56:** 449-453.

Warén, A. & Gofas, S. 1997. A new species of Monoplacophora, redescription of the genera *Veleropilina* and *Rokopella*, and new information on three species of the class. *Zoologica Scripta* **25:** 215-232.

Warén, A. & Hain, S. 1992. *Laevipilina antarctica* and *Micropilina arntzi*, two new monoplacophorans from the Antarctic. *The Veliger* **35:** 165-176.

Molluscan Research **19(1):** 59-68 *(1998)*

Anatomy and relationships of the papuinine land snail *Meliobba shafferyi* Iredale, 1940 (Pulmonata: Stylommatophora: Camaenidae)

Bronwen Scott

Cooperative Research Centre for Tropical Rainforest Ecology and Management,
Department of Zoology and Tropical Ecology,
James Cook University of North Queensland,
Townsville, Queensland 4811, Australia

Abstract

Meliobba Iredale, 1940, is a small genus of papuinine (arboreal camaenid) snails from Australia and New Guinea, originally diagnosed on shell characters only. The distal reproductive anatomy, head wart, jaw and radula of the type species, *Meliobba shafferyi* Iredale, 1940, are described, providing a wider set of characters on which the generic diagnosis may be based. Anatomical characters of this species are compared with that of *Rhynchotrochus macgillivrayi* (Forbes, 1852) and similarities between the reproductive tracts of the two taxa indicate that they may be closely related. The head wart, which is present in many camaenid genera, is identified as a useful character for determining phylogenetic relationships. It is suggested that the papuinine snails may not form a monophyletic group but may represent multiple convergences of shell shape and ecology.

Key words: Camaenidae, *Meliobba*, anatomy

Introduction

Papuinines are medium to large arboreal snails found in the forests of eastern Australia, New Guinea and adjacent islands, west to the Moluccas (Clench & Turner, 1962). They are grouped according to conchological and ecological characteristics (elevated shells, tree-dwelling habit), but no morphological synapomorphies define the papuinines as a monophyletic assemblage. Although some work has done on the taxonomy of papuinines (Clench & Turner, 1959, 1960, 1962, 1964, 1966, 1968), little is known of their phylogenetic relationships.

Nine species of papuinine snails have been recorded from Australia (Smith, 1992), of which five are known from the tropical north-eastern closed forests. The most recently described is *Meliobba shafferyi*, named by Iredale in 1940 from a single shell collected in the Mossman area of North Queensland (Fig. 1). The shell resembled that of no other species from Australia, but Iredale (1940) recognised *M. shafferyi* as having strong affinities with at least one species from southern New Guinea. Although he maintained *Meliobba* as a monotypic genus, he erected a second genus, *Negotobba* Iredale, 1941, to cover similar shells from New Guinea. *Helix goldiei* Brazier, 1884 from Mt Astrolabe and the Owen Stanley Range, New Guinea, was designated as type species. *Meliobba* and *Negotobba* were diagnosed on shell characters alone (Iredale, 1940, 1941).

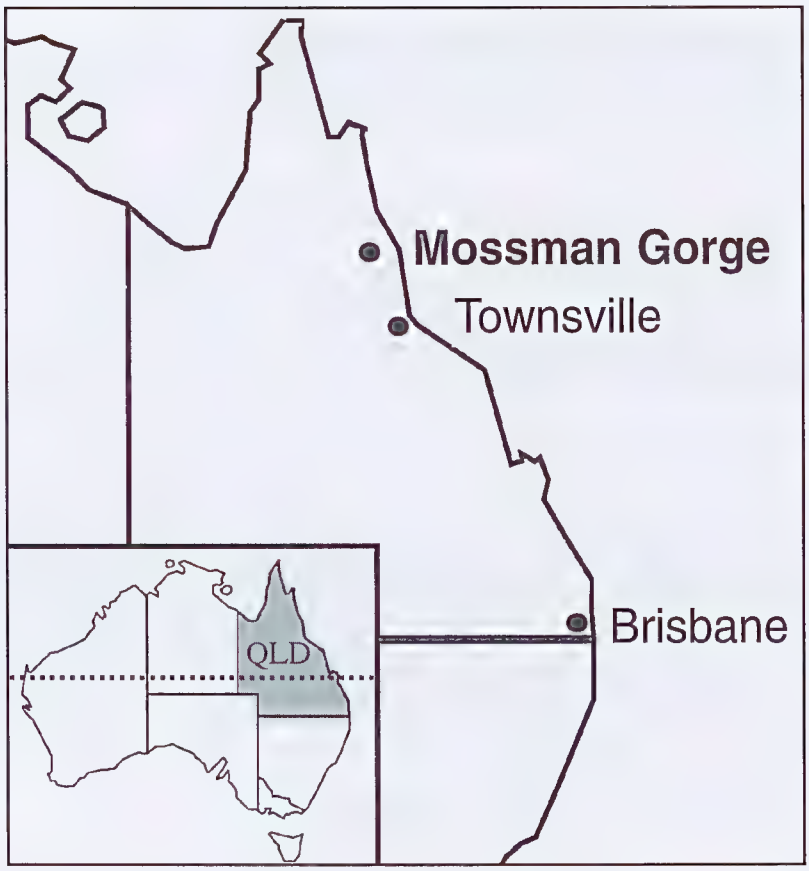


Figure 1. Type locality and known range of *M. shafferyi* (•) at Mossman Gorge, near the township of Mossman.

Clench & Turner (1962) synonymised *Negotobba* with *Meliobba*. They recognised *M. shafferyi* from Australia and five additional species from New Guinea including *goldiei* (Clench & Turner, 1960, 1962). Shells of all six species were described, as was the genital anatomy for those of which they had wet material. However, as anatomical material of neither *shafferyi* nor of *goldiei* was available at that time, Clench & Turner (1962) were unable to describe the type species of either *Meliobba* or *Negotobba* in detail.

The genus *Meliobba* is based on characters of the shell, which may be unreliable. However, character-state convergences in shell shape are so widespread among pulmonates that family- and even genus-level synapomorphies are rare (Goodfriend, 1986; Nordsieck, 1986).

Very few specimens of *Meliobba shafferyi* are held in museums and, until recently, material available for study was restricted to shells only. A single wet specimen, recently deposited in the collection of the Museum of Tropical Queensland, provided an opportunity to describe the anatomy of this species and to examine its relationships within the papuinine lineage.

Materials and Methods

A single adult *Meliobba shafferyi* was collected from rainforest at Mossman Gorge, near the township of Mossman, north-eastern Queensland (MTQ MO40193). The specimen was relaxed and killed by freezing (Scott, 1991), fixed in formalin, and stored in 70% ethanol. As this specimen constitutes the only anatomical material currently available, I did not want to damage it unnecessarily. It was impossible to extract the specimen without breaking the shell, so I could not examine the apical reproductive tract, and the specimen was dissected to allow examination of the terminal genitalia only. The terminal genitalia were examined under a dissecting microscope and drawn free-hand (the camera lucida distorts images of large three-dimensional objects, so was not used). The radula was removed and stained with lignin pink for examination under the light microscope, then stored in 70% ethanol with the rest of the specimen. A permanent mount (either slide or SEM stub) was not made for reasons outlined above. The jaw was examined in situ.

Material held in museum collections was also examined to allow comparison of shell and anatomical features. Museum abbreviations are: Australian Museum, Sydney (AM), Museum of Comparative Zoology, Cambridge, Mass. (MCZ), and Museum of Tropical Queensland, Townsville (MTQ).

Material examined

Meliobba shafferyi Iredale, 1940. Holotype, dry, AM C.62205. Queensland, Mossman (= Mossman Gorge).

Meliobba helenae Clench & Turner, 1960. Holotype, dry, AM C.062378. Papua New Guinea, Asai-Simba Divide, Schrader Range, due W of Aiome (5°05'S, 144°50'E). 24 Feb. 1960. Coll: R. Bullmer.

Meliobba mcmichaeli Clench & Turner, 1962. Holotype, dry, AM C.062377. Indonesia, Irian Jaya, Noordweg, Jayapura. 25 Jul. 1959. Coll: R.T. Simon-Thomas.

Meliobba popondetta Clench & Turner, 1962. Holotype, dry, AM C.062376. Papua New Guinea, Mamoo Estate, near Popondetta (8°46'S, 148°19'E). 31 Aug. 1957. Coll: D.F. McMichael.

Rhynchotrochus taylorianus (Adams & Reeve, 1850). 1 live adult, wet, MCZ unreg. Papua New Guinea, Surawaged Mts, Gwengwumgwak nr Wantoat, 3500'. 23 July 1957. Coll. D.F. McMichael.

Rhynchotrochus kubaryi (Möllendorff, 1895). 5 live adults, wet, MCZ unreg. Irian Jaya, New Pionierbivak. Aug. - Oct. 1958. Coll. J.M. Krösschell.

Rhynchotrochus macgillivrayi (Forbes, 1852). 1 live adult, wet, MTQ MO40194. NE Queensland, Etty Bay (17°34'S, 146°05'E). 2 Oct. 1989. Coll: A. Young, P. Meikle.

Results

Meliobba shafferyi Iredale, 1940

Clench & Turner, 1962; Smith, 1992.

Shell

Shell large, lenticular (Fig. 2a), dark horn with lighter sculpture and pale peripheral keel, protoconch dark. Height 27.6 mm, diameter 43.6 mm (measurements include apertural lip). Whorls 5. Spire low, evenly elevated, h/d ratio 0.63. Sutures not impressed. Body whorl keeled. Protoconch sculpture faint, of low radial riblets. Teleoconch sculpture of radial growth lines, overlain by thick plaited wrinkles, which are oblique above the keel and radial below it. Aperture keeled, internal height 15.4 mm, internal width 19.3 mm. Lip glossy white, expanded (max. width 4.4 mm) and reflected, simple except for low tooth on columellar lip. Imperforate.

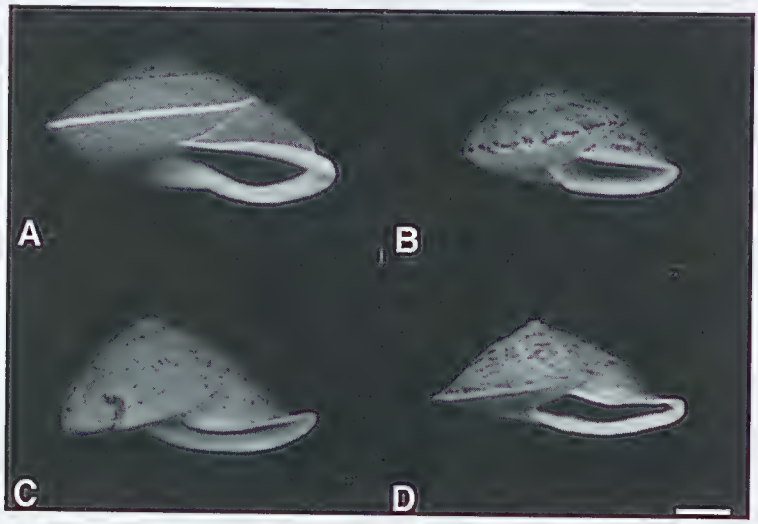


Figure 2. Shells of *Meliobba*. **A.** *M. shafferyi*. **B.** *M. popondetta*. **C.** *M. mcmichaeli*. **D.** *M. helenae*. Scale bar = 10 mm.

External appearance of live animal

Body with orange tubercles on black background. Foot fringe orange. Sole tripartite, with dark grey edges and light grey central portion. Tentacles orange, front of head dark grey. Elongate 'head wart' between upper tentacles (Fig. 3). Mantle collar dark grey to black; mantle over pulmonary cavity unpigmented.

Reproductive tract

Spermoviduct coiling around spermathecal duct. Spermathecal duct massive, attenuated proximally, but otherwise greatly swollen, with thick muscular walls (Fig. 4). Free oviduct approx. 9.5 mm long, 1.8 mm wide, joining vagina at right angle. Vagina approx. 9 mm long, 3.8 mm wide. Interior vaginal walls lined with smooth longitudinal ridges, becoming convoluted at opening of free oviduct, continuing in duct of spermatheca as crenulate ridges. Internal differentiation in sculpture of walls of vagina and spermathecal duct distinct.

Vas deferens 1.2mm wide adjacent to vagina on female side (Fig. 4), 0.6 mm on male side, enters epiphallus close to small (1.5 mm) recurved flagellum (Fig. 5). Epiphallus tubular, longer than penis (epiphallus = 44 mm). Penis sheath absent, but vas deferens, epiphallus and penis bound together by thick mesenteries. Penis papilla large (9 mm long), occupying almost whole of penis lumen. Papilla broad, flattened, coiled into conical shape (Fig. 6). Papilla heavily sculptured. Sperm channel from opening of epiphallus into penis to proximal papilla. Sculpture of penis lining (external wall when everted) similar to that of penis papilla but less pronounced. Penis wall thin proximally (around penis papilla), much thicker distally.

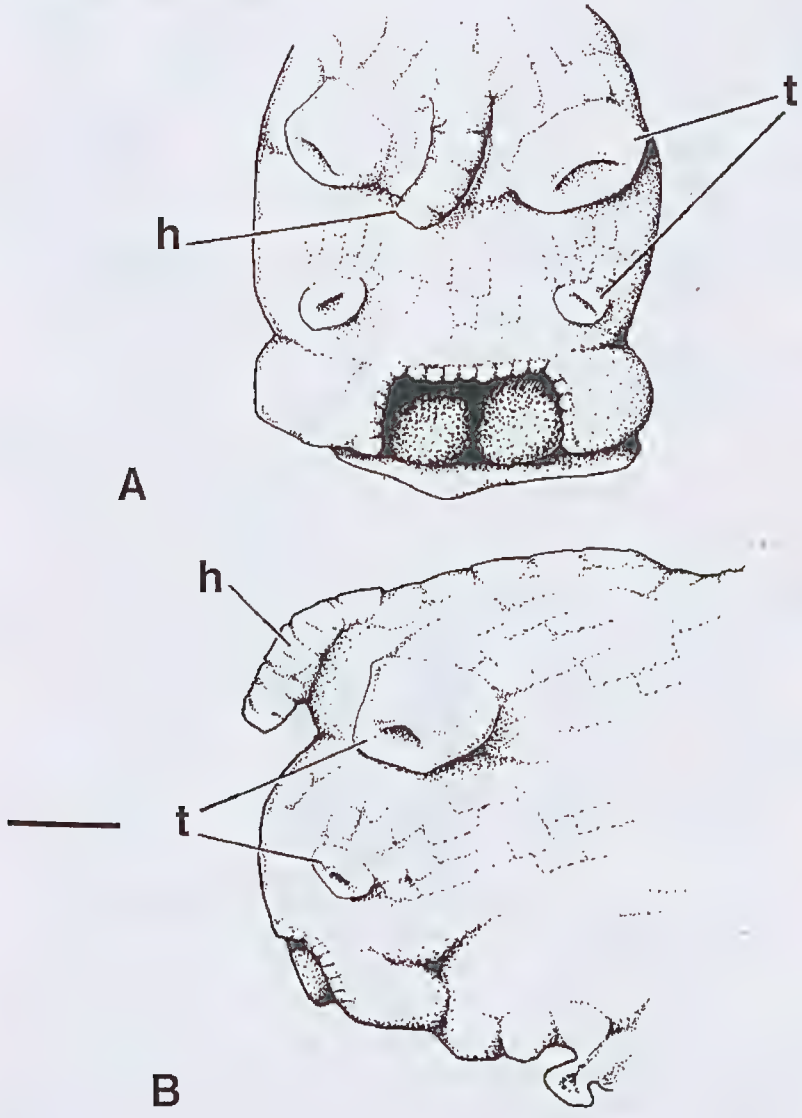


Figure 3. Head wart of *M. shafferyi*. A. Anterior view. B. Lateral view. Scale bar = 2 mm. Abbreviations: **hw**, head wart; **t**, tentacles.

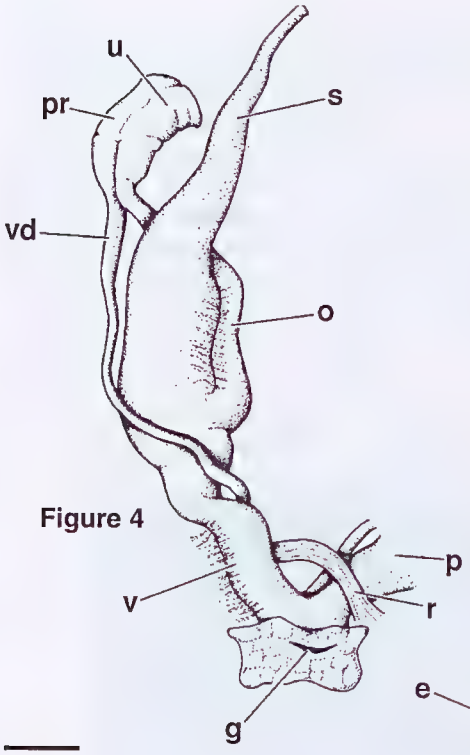


Figure 4

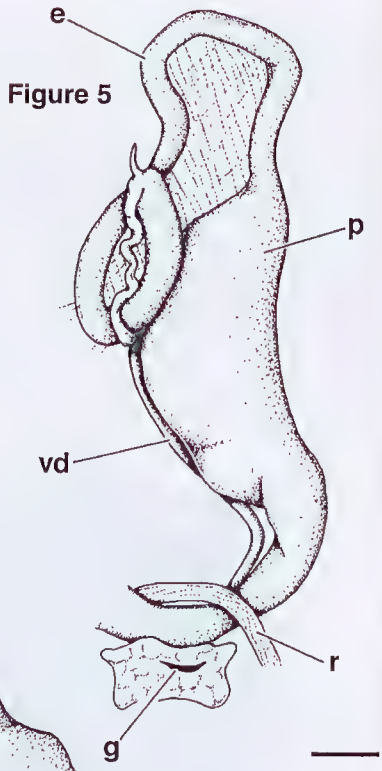


Figure 5

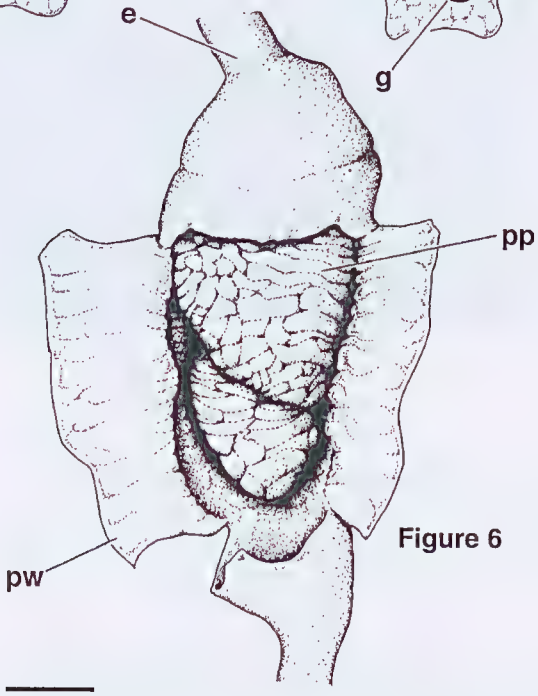


Figure 6

Figure 4. Female genitalia of *M. shafferyi*. Scale bar = 2 mm. Abbreviations: **g**, genital opening; **m**, tentacular retractor muscle; **o**, free oviduct; **p**, penis; **pr**, prostate; **s**, spermathecal duct; **u**, uterus; **v**, vagina; **vd**, vas deferens. **Figure 5.** Male genitalia of *M. shafferyi*. Scale bar = 2 mm. Abbreviations: **e**, epiphallus; **g**, genital opening; **m**, tentacular retractor muscle; **p**, penis; **vd**, vas deferens. **Figure 6.** Penis interior of *M. shafferyi*. Scale bar = 2 mm. Abbreviations: **e**, epiphallus; **pp**, penis papilla; **pw**, wall of penis.

Jaw and radula

Jaw 1.1 mm deep, 3mm wide, strongly curved, with 12 low narrow ribs. Central tooth of radula with spatulate cusp, laterals similar with minor asymmetry, marginals not observed but cusps of transitional teeth demonstrate asymmetry with small endocone and distinct ectocone.

Discussion

Shell shape in *Meliobba shafferyi* generally resembles that of other species assigned to *Meliobba* with minor differences in the width of the lip, shape of the aperture, and the degree of umbilical closure. In none of the three species examined is the lip as wide as that of *M. shafferyi*, nor is the umbilicus wholly occluded, although that of *M. helenae* is almost closed (Clench & Turner, 1960, pl. 3, 1962, pl. 2-3). There is also some difference between species in the curve of the dorsal body whorl immediately behind the lip. In *M. shafferyi* and *M. popondetta*, the external shell wall is convex like the preceding portion of the body whorl, as is the palatal lip (Fig. 2a,b); in *M. mcmichaeli* and *M. helenae* the wall is concave, with a corresponding curve in the lip and constriction in the aperture (Fig. 2c, d). This can also be seen in illustrations of *M. goldiei* and *M. lintschuana* (Clench & Turner, 1962: pl. 2-3). However, it should be remembered that the sample sizes are very small (in most cases, holotype only), so the variation within species can not be determined.

Despite marked similarities in shell shape, differences between the reproductive tract of the type species and of those illustrated for congeneric species (Clench & Turner, 1962, figs. 7-9; 1966, figs. 1-6) suggest that *Meliobba* sensu Clench & Turner is a complicated genus and may not be a monophyletic group. The base of the spermathecal duct of *M. shafferyi* is grossly swollen and the duct is proportionately longer than that recorded from other species of *Meliobba* except for *M. helenae* (Clench & Turner, 1962, figs. 7-9). The epiphallus is slender (readily distinguishing it from the penis) and the penis papilla is large, unlike that of the other congeneric species for which anatomical data are available (Fig. 6; Clench & Turner, 1962, figs. 7-9). The epiphallic flagellum is short and recurved, a condition also found in *M. mcmichaeli* and *M. popondetta* but not in M. *helenae* (Clench & Turner, 1962). Character states display a 'mosaic' distribution with the result that it is difficult to diagnose the genus satisfactorily on reproductive characters. There appears to be no well-defined anatomical synapomorphy uniting the group, a situation which reflects the taxonomic problems associated with Camaenidae as a whole (Scott, 1996).

The terminal male and female genitalia of *Meliobba shafferyi* show many similarities to those structures considered diagnostic of *Rhynchotrochus* (Clench & Turner, 1966). In both taxa the spermathecal duct is long and attenuated, the free oviduct is swollen at the base, a short, recurved epiphallic flagellum is present at the junction of epiphallus and vas deferens, the penis wall (penis sheath of Clench & Turner, 1966) is thin proximally and much thicker distally, and the penis papilla is large with a marked sperm gutter along one side (Clench & Turner, 1966).

Radular teeth are comparable to those of other species of *Meliobba* and also of *Rhynchotrochus* (Clench & Turner, 1962, fig. 3, 1966, figs. 1, 4-6), with a spatulate central tooth and broad mesocone on the lateral teeth.

	M. shafferyi	*M. helenae*
body	orange on black	dark brown
tentacles	orange	nearly black
upper surface of foot	orange	yellow
sole	light grey	deep ivory
edge of sole	dark grey	yellow

TABLE 1. Colour patterns in living *M. shafferyi* and *M. helenae* (data from Clench & Turner, 1960)

External features of *M. shafferyi* may provide the most important clues to its evolutionary relationships, but so little information on New Guinea and Australian papuinines is currently available that no conclusions can be drawn, only comparisons made. The striking colour pattern on the living animal (orange on black) differs strongly from that reported for *M. helenae*, the only other *Meliobba* observed alive (Clench & Turner, 1960) (Table 1). Bright and contrasting colours are rare among snails, so this unusual pattern may be significant phylogenetically.

The 'head wart' of *M. shafferyi* is also distinct. It is elongate and tubular, resembling neither the head wart structure of other Australasian camaenids and Asian Bradybaenidae (Taki, 1935; Solem, 1992; Scott, unpubl. data) or the cephalic (frontal) organ of the African Urocyclidae (Binder, 1969). It is such a large and obvious structure that if it were present in *M. helenae* it would certainly have been recorded by Clench & Turner (1960) when they examined their living specimen. The tropical Australian species *Rhynchotrochus macgillivrayi* also appears to possess a head wart, but this is a low circular self-coloured structure similar to that of other Australasian camaenids, such as *Rhagada* of northern Western Australia (Solem, 1985) and the hadroid camaenids of eastern Queensland (Solem, 1992; Scott, unpubl. data). It does not resemble that of *M. shafferyi* in any way except position. Evidence from reproductive tract characters suggests that *Meliobba* and *Rhynchotrochus* are closely related, the structure of the head wart suggests that they are not, and conchological evidence is equivocal.

Elaborate structures, such as the head wart, are useful in phylogenetic reconstructions, whereas characters of the shell are more likely to exhibit convergence and confuse analyses (Cain, 1982). The head wart is present in many Australian camaenids including *Hadra* and its allies (Solem, 1992; Scott, unpubl. data), *Rhagada* (Solem, 1985), the eastern Asian *Camaena* and some central Australian genera (Solem, 1993). It is also found in the Asian Bradybaenidae, the family from which it was first described (Taki, 1935; Takeda, 1982). In Australian camaenids the organ varies from a patch of specialised tubercles to a fully-eversible wart which can be retracted into a transverse slit when not in use (Solem, 1992; Scott, unpubl.data). States appear to be discrete, so each state may be regarded as a synapomorphy uniting taxa in distinct lineages. The head wart of *Meliobba shafferyi* is more strongly developed than that of other Australasian camaenids and so may be used to define another lineage within the group. Whether this structure occurs in *Papuina sensu stricto*

is not known, but its study, together with that of characters of the genitalia, pallial complex and nervous system, may determine whether or not the papuinines represent a true clade.

Acknowledgements
Thanks to the following people for access to specimens or for searching through collections for wet material on my behalf: Dr Carden Wallace and Dr Peter Arnold (MTQ), Dr Winston Ponder and Ian Loch (AM), and Prof. Ken Boss and Adam Baldinger (MCZ).

References

Binder, E. (1969). Cephalic accessory sexual organ of *Gymnarion*: speciation and phylogeny (Pulmonata, Helicarionidae). *Malacologia* **9**: 59-64.

Cain, A.J. 1982. On homology and convergence, in *'Problems of phylogenetic reconstruction.'* Joysey, K.A. and Friday, A.E. (eds.), Systematics Association, London.

Clench, W.J. & Turner, R.D. 1959. Two new genera of land molluscs (Papuininae) from the Central Highlands of New Guinea. *Journal of the Malacological Society of Australia* **1(3)**: 4-9.

Clench, W.J. & Turner, R.D. 1960. A new *Meliobba* from the Schrader Range, New Guinea. *Journal of the Malacological Society of Australia* **1(4)**: 30-31.

Clench, W.J. & Turner, R.D. 1962. Monographs of the genera *Papustyla, Forcatia* and *Meliobba* (Papuininae: Camaenidae). *Journal of the Malacological Society of Australia* **1(6)**: 3-33.

Clench, W.J. & Turner, R.D. 1964. Monographs of the genera *Megalacron* and *Rhytidoconcha* (Papuininae: Camaenidae). *Journal of the Malacological Society of Australia* **1(8)**: 36-70.

Clench, W.J. & Turner, R.D. 1966. Monograph of the genus *Rhynchotrochus* (Papuininae: Camaenidae). *Journal of the Malacological Society of Australia* **1(9)**: 59-95.

Clench, W.J. & Turner, R.D. 1968. Monograph of the genus *Letitia* (Papuininae: Camaenidae). *Journal of the Malacological Society of Australia* **1(11)**: 32-49.

Goodfriend, G.A. 1986. Variation in land-snail shell form and size and its causes: a review. *Systematic Zoology* **35**: 204-223.

Iredale, T. 1938. Basic list of the land Mollusca of Australia - part III. *Australian Zoologist* **9**: 83-124.

Iredale, T. 1940. A New Guinea land shell in Queensland. *Australian Naturalist* **10**: 239-240.

Iredale, T. 1941. A basic list of the land Mollusca of Papua. *Australian Zoologist* **10**: 51-94.

McMichael, D.F. 1958. A new tree-snail from North Queensland. *Journal of the Malacological Society of Australia* **1(2)**: 41-43.

Nordsieck, H. 1986. The system of the Stylommatophora (Gastropoda), with special regard to the systematic position of the Clausiliidae. II. The importance of the shell and distribution. *Archiv für Molluskenkunde* **117**: 93-116.

Scott, B.J. 1991. Freezing technique for relaxing and killing terrestrial snails. *Australian Shell News* **77**: 2

Scott, B. 1996. Phylogenetic relationships of the Camaenidae (Gastropoda: Pulmonata: Stylommatophora). *Journal of Molluscan Studies* **62**: 65-73

Smith, B.J. 1992. Non-marine Mollusca, in *Zoological Catalogue of Australia, 8.* Houston, W.W.K. (ed.). Australian Government Publishing Service, Canberra.

Solem, A. 1985. Camaenid land snails from Western and central Australia (Mollusca: Pulmonata: Camaenidae). V. Remaining Kimberley taxa and addenda to the Kimberley. *Records of the Western Australian Museum, Supplement* **20**: 707-981

Solem, A. 1992. Camaenid land snails from southern and eastern South Australia, excluding Kangaroo Island. *Records of the South Australian Museum, Monograph series* 2: 1-325

Solem, A. 1993. Camaenid land snails from Western and central Australia (Mollusca: Pulmonata: Camaenidae) VI. Taxa from the Red Centre. *Records of the Western Australian Museum, Supplement* **43**: 983-1459.

Takeda, N. 1982. Notes on the fine structure of the head-wart in some terrestrial snails. *Veliger* **24**: 328-330.

Taki, I. 1935. Notes on a warty growth on the head of some land snails. *Journal of Science of the Hiroshima University, Series B, Division 1* **3**: 159-183.

Molluscan Research **19(1):** 69-72 *(1998)*

Food and feeding mode of Thysanodontinae (Mollusca: Gastropoda: Calliostomatidae)

Bruce A. Marshall

Museum of New Zealand Te Papa Tongarewa
P.O. Box 467, Wellington, New Zealand

Abstract
Thysanodontinae are reported to feed on Stylasteridae (Cnidaria: Hydroida).

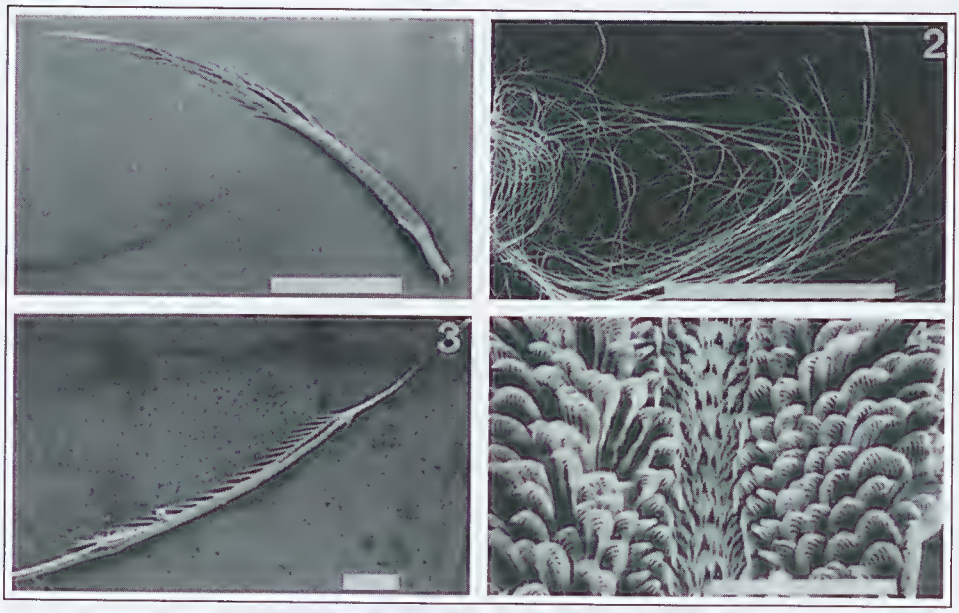
Key words: Mollusca, Calliostomatidae, Thysanodontinae, Cnidaria, Stylasteridae.

Introduction

Thysanodontinae was introduced for a group of species with a bizarre radular morphology unique among Trochoidea. It was originally interpreted as a subfamily of Trochidae related to Calliostomatinae (Marshall, 1988), later (Marshall, 1995a, b) as a subfamily of Calliostomatidae (Trochoidea). At about 2.4 μm wide and 1.10 - 3.40 mm long, the moderately flexible, hair-like radular teeth are the most slender of any known mollusc, each having a long, finely tapered tip, behind which is a series of fine, backwardly inclined barbs (Figs 1-3). All other calliostomatids (Calliostomatinae) have radulae that are variations on a standard rhipidoglossate radular plan, with short central and lateral teeth and slender outer marginal teeth, the stouter innermost marginals being the main food cutting teeth (Marshall, 1995b) (Fig. 4). All calliostomatines are carnivores, the majority feeding on thecate hydroids (Leptomedusae), anemones and scleractinean corals (Anthozoa) (Ferro and Cretella, 1993; Marshall, 1988 and references therein). A few species feed exclusively on sponges (Porifera), whereas others have been observed eating carrion (Marshall, 1988, 1995b). Since thysanodontine teeth pack the anterior alimentary tract and were clearly unsuited for food preparation and gathering work of the types performed by other rhipidoglossate gastropods, I originally concluded that the food had to be fluid, perhaps liquified by proteolytic enzyme, and that the radula might be used to penetrate and process soft-bodied prey with a push/pull action (Marshall, 1988).

Associations

There are three positive associations and a deduced association with living Stylasteridae (Cnidaria: Hydroida) from within the New Zealand region. The data are as follows: (1) three living adult specimens of *Thysanodonta wairua* Marshall, 1988, deeply entangled among branches of a large colony of living *Errina* sp. from off Three Kings Islands (craypot, c. 100 m; Burch collection, Whangarei); (2) one adult specimen of *Carinastele kristelleae* Marshall, 1988, taken alive from a living colony of *Errina novaezelandiae* Hickson, 1912, from unnamed rock off the north end of Cording Island, Preservation Inlet, Fiordland (25 m,



Figures 1-4.
1. Almost entire radula (minus a few teeth) of holotype of *Carinastele kristelleae* Marshall, 1988, Cook Strait, New Zealand, 256-274 m.
2. Tangle of teeth from radula of paratype of *Thysanodonta eucosmia* Marshall, 1995, off southern New Caledonia, 470 m.
3. Tip of single radular tooth of holotype of *Thysanodonta aucklandica* Marshall, 1988, off Auckland Islands, New Zealand, 549 m.
4. Almost full width of section of radula of *Calliostoma tricolor* Gabb, 1865, off San Diego, California, 55 m.
Scale bars 1, 2 = 1000 μm, 3 = 20 μm, 4 = 500 μm.

scuba, A. Penniket, February 1995; Museum of New Zealand, Wellington, NMNZ M.131454); (3) 12 adult specimens of *Carinastele kristelleae* taken alive from living colonies of *Errina novaezelandiae,* from opposite Adam Head, Long Sound, Preservation Inlet, Fiordland (15-18 m, 18 August 1996, scuba, C.D. Paulin; NMNZ M.131683); (4) one live specimen and four shells of *Carinastele kristelleae* dredged from a hard, current-scoured substratum with common live colonies of *Errina cooki* Hickson, 1912, Cook Strait narrows (256-274 m, 29 September 1976; NMNZ M.55026, M.80705).

Numerous specimens of several thysanodontines have been dredged off southern New Caledonia (Marshall, 1995b; additional material Musèum National d'Histoire Naturelle, Paris) together with rich stylasterid faunas and other associated biota (P. Bouchet, pers. comm.). Herbert (1995) suggested that specimens of the southern African species *Herbertina hayesi* Herbert, 1995 taken alive from crayfish traps may have been attracted to fish used as bait. Although we cannot preclude this possibility, they may well have been brought to the surface entangled in stylasterids, which are common in the area (D.G. Herbert, pers. comm.), or other residue.

Conclusion

Presumably thysanodontines feed on stylasterid tissues, which they reach by thrusting the clustered radular teeth deep into individual gastropores (none of which exceed 280 μm width in the associated *Errina* species).

Acknowledgements

I am grateful to Kevin Burch (Whangarei) and Andrew Penniket (Dunedin) for first drawing my attention to the association between *Errina* and live thysanodontines, Chris Paulin (Museum of New Zealand, Wellington) for the specimens from Long Sound, Philippe Bouchet (Musèum National d'Histoire Naturelle, Paris) for comments on New Caledonian biota, Stephen Cairns (National Museum of Natural History, Washington D.C.) for identifications of *Errina* species, and Dai Herbert (Natal Museum, Pietermaritzberg) for comments on the manuscript.

References

Ferro, R. & Cretella, M. 1993. Osservazione sulla biologia di *Calliostoma granulatum* (Born) (Gastropoda: Trochidae). *Bollettino Malacologico* **29:** 49-56.

Herbert, D.G. 1995. A new species of Thysanodontinae from South Africa (Mollusca: Trochoidea). *Annals of the Natal Museum* **36:** 255-259.

Marshall, B.A. 1988. Thysanodontinae: a new subfamily of the Trochidae (Gastropoda). *Journal of Molluscan Studies* **54:** 215-229.

Marshall, B.A. 1995a. A revision of the Recent Calliostoma species of NewZealand (Mollusca: Gastropoda: Trochoidea). *The Nautilus* **108:** 83-127.

Marshall, B.A. 1995b. Calliostomatidae (Gastropoda: Trochoidea) from NewCaledonia, the Loyalty Islands, and the northern Lord Howe Rise. Rèsultats des Campagnes Musorstom 14. *Memoires de la Musèum National d'Histoire Naturelle* **167:** 381-458.

Molluscan Research **19(1)**; 73 -106 *(1998)*

A review of the Recent Trochini of New Zealand (Mollusca: Gastropoda: Trochidae)

Bruce A. Marshall

Museum of New Zealand Te Papa Tongarewa
P.O. Box 467, Wellington, New Zealand.

Abstract

New Zealand Recent Trochini are revised, illustrated and keyed. Eleven species are recognised, including four new species of *Thoristella*. A new subgenus of *Trochus* is introduced for *Trochus camelophorus* Webster, 1906. The following taxa are newly synonymised with *Thoristella chathamensis* (Hutton, 1873): *Trochus oppressus dunedinensis* Suter, 1897, *Calliostoma aucklandicum* E.A. Smith, 1902 and *Thoristella chathamensis cookiana* Powell, 1934. *Trochus carmesina* Webster, 1908 is transferred from *Talopena* to *Thoristella*, and *Thoristella fossilis* Finlay, 1926 is transferred to *Trochus (Coelotrochus)*. Lectotypes are designated for *Trochus tiaratus* Quoy and Gaimard, 1834, *Trochus viridis* Gmelin, 1791, *Polydonta viridescens* A. Adams, 1853, *Polydonta elegans* Gray, 1835, *Polydonta tuberculata* Gray, 1843, *Trochus fulvolabris* Hombron and Jacquinot, 1854, and *Calliostoma aucklandicum* E.A. Smith, 1902.

Key words: Recent, New Zealand, Mollusca, Gastropoda, Trochidae, Trochini, *Trochus*, *Thoristella*, lectotypes, new taxa.

Introduction

Trochus and *Thoristella* species are common and significant components of the New Zealand marine biota. All live on hard substrata with the exception of *Trochus tiaratus* Quoy and Gaimard, 1834, which may also live on mud and sand. Judging from gut contents most if not all appear to be detritivores. Whereas the New Zealand *Trochus* and *Clanculus* species are well known, *Thoristella chathamensis* (Hutton, 1873) has been subdivided into a number of geographic and a "bathymetric" subspecies that prove to be untenable, and the affinities of *Thoristella carmesina* (Webster, 1908) have been obscured through misplacement in *Talopena*. The present contribution includes discussions of the affinities of these taxa, and descriptions of four new Recent species of *Thoristella*.

Abbreviations and text conventions:

AIM - Auckland Institute and Museum;
AMS - Australian Museum, Sydney;
BMNH - The Natural History Museum, London;
MNHN - Muséum National d'Histoire Naturelle, Paris;
NMNZ - Museum of New Zealand Te Papa Tongarewa, Wellington;
NZGS - Institute of Geological and Nuclear Sciences, Lower Hutt.

Height dimension precedes width in all references to shell measurements. All material is at NMNZ unless specified (registration numbers preceded by "M.").

Systematics

Superfamily **TROCHOIDEA** Rafinesque, 1815
Family **TROCHIDAE** Rafinesque, 1815
Subfamily **TROCHINAE** Rafinesque, 1815
Tribe **TROCHINI** Rafinesque, 1815
Genus **Trochus** Linnaeus, 1758.

Trochus Linnaeus, 1758: 756.
Type species (by subsequent designation of Iredale, 1912: 225): *Trochus maculatus* Linnaeus, 1758; Recent, tropical Indo-Pacific.

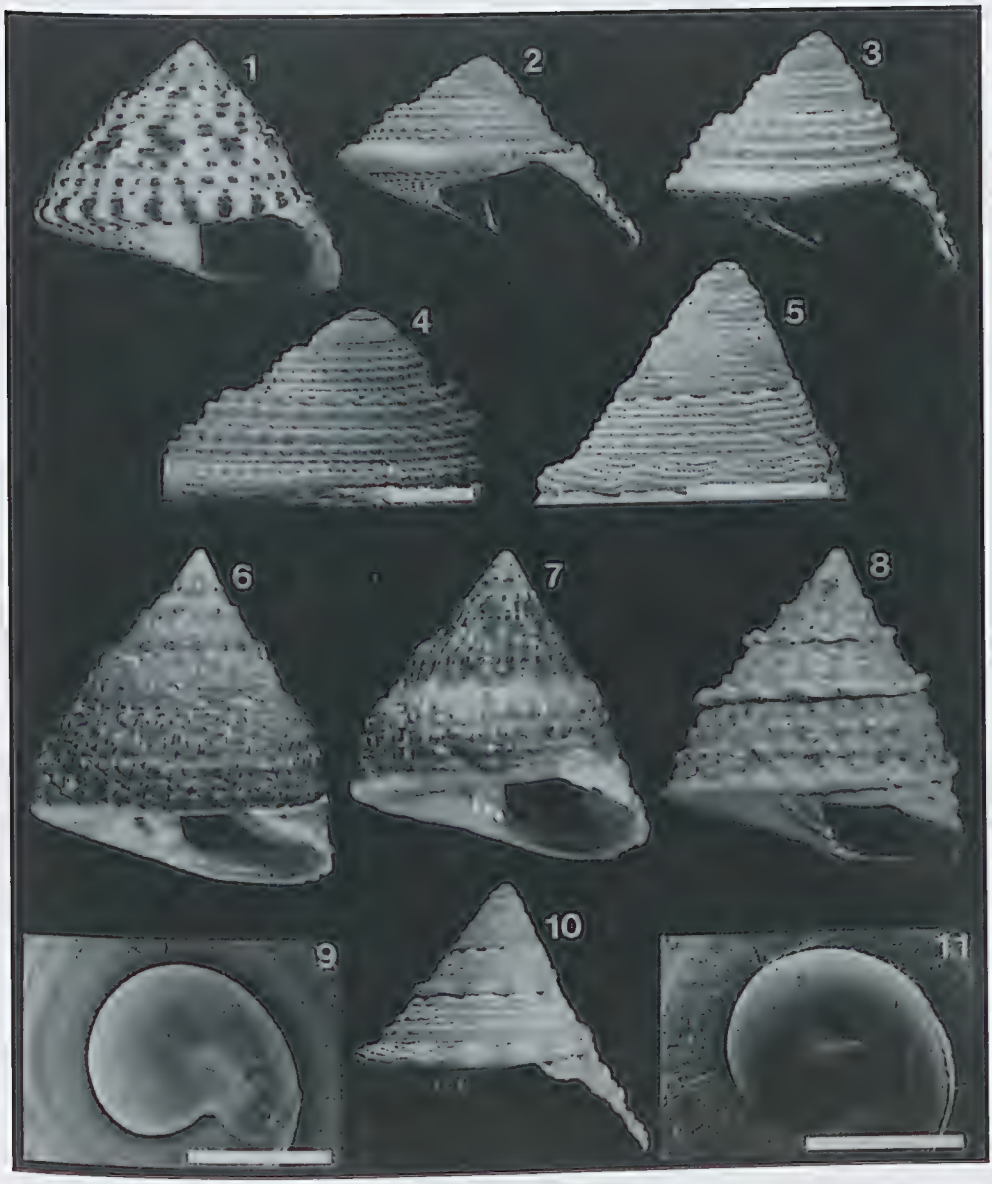
Remarks: Division of *Trochus* into well-defined subgenera is problematic (Herbert, 1993). In tropical and subtropical Indo-Pacific species currently referred to *Trochus* (s. str.) the columella edge may be smooth or dentate, there may be one or more spiral cords within the umbilicus, and the periphery may be stellate or smooth. The degree of development of axial lamellae is interspecifically variable.

All species examined currently referred to *Trochus, Coelotrochus* Fischer, 1879, *Infundibulops* Pilsbry, 1889, *Thorista* Iredale, 1915 and *Thoristella* Iredale, 1915 have essentially similar radulae, and the only major dichotomy in external anatomy that I am able to detect is the relatively larger cephalic tentacles in *Thoristella* species. Hickman and McLean (1990) have suggested that *Coelotrochus, Thorista* and *Thoristella* should perhaps be treated as discrete genera, but this seems difficult to justify for *Coelotrochus* and *Thorista,* which have traditionally been treated as subgenera of *Trochus* (Thiele, 1929; Wenz, 1938; Keen, 1960). *Thoristella* is interpreted as a genus for the endemic New Zealand radiation of small species, which are presumably derived from *Trochus.* A new subgenus of *Trochus* is introduced for *Trochus camelophorus* Webster, 1906.

Subgenus **Coelotrochus** Fischer, 1879

Coelotrochus Fischer, 1879: 417.
Type species (by monotypy): *Trochus tiaratus* Quoy and Gaimard, 1834; Recent, New Zealand.
Neozelandia Cossmann, 1918: 220.
Type species (by original designation): *Trochus tiaratus* Quoy and Gaimard, 1834; Recent, New Zealand.

Remarks: Herbert (1993) placed the southern African species *T. nigropunctatus* Reeve, 1861, and *T. cariniferus* Beck in Reeve, 1842 in subgenera *Trochus* and *Infundibulops* respectively, the latter differing primarily in lacking spiral cords within the umbilicus. Both of these species resemble the type species of *Coelotrochus* in shape and in that the periphery is not stellate, *T. nigropunctatus* also having strongly developed axial lamellae. Whether or not one or both of these southern African species belongs in *Coelotrochus* is unclear, but it is possible that the combination of non-stellate periphery and well-developed axial lamellae may be the only shell character states diagnostic of the subgenus.



Figures 1-11.
Shells of *Trochus* species. **1-4, 9.** *T. tiaratus* Quoy and Gaimard. **1.** Whangaroa Harbour, main channel opposite Kopumiti Point, 15-9 m, M.35329 (13.4 x 15.6 mm). **2,4** (juvenile),**9** (protoconch). Rangaunu Bay, 23 m, M.127373 (4.30 x 7.20 mm). **3.** Sportsman's Cove, Dusky Sound, Fiordland, 15 m, M.58940 (5.00 x 6.70 mm). **5-8,10,11.** *T. viridis* Gmelin. **5,10.** Juvenile, Otanerau Bay, East Bay, Arapawa Island, Queen Charlotte Sound, 20-29 m, M.50859 (7.00 x 8.60 mm). **6.** Tryphena, Great Barrier Island, littoral, M.90778 (25.5 x 23.0 mm). **7.** Timaru breakwater, littoral, M.5307 (19.0 x 17.0 mm). 8. Horseshoe Bay, Stewart Island, beach, M.130014 (25.5 x 23.0 mm). **11.** Protoconch, Whangaroa Harbour entrance, main channel, 20 m, M.41100. Scale bars 4, 5 = 1 mm, others = 170 μm.

Trochus (Coelotrochus) tiaratus (Quoy and Gaimard, 1834)
(Figs 1-4, 9, 12)

Trochus tiaratus Quoy and Gaimard, 1834: 256, pl. 64, fig. 6-11; Kiener, 1850: pl. 22, fig. 2; Philippi, 1855: 280, pl. 41, fig. 5; Fischer, 1875: 90, pl. 22, fig. 2; Pilsbry, 1889: 42, pl. 12, fig. 72-74.
Polydonta elegans Gray, 1835: 309; Gray, 1843: 238; Gray, 1856: 468.
?Trochus delicatulus Philippi, 1846: 105; Philippi, 1851: 176, pl. 28, fig. 1.
Polydonta tiarata.- Hutton, 1873: 36.
Trochus (Coelotrochus) tiaratus.- Fischer, 1879: 417; Hutton, 1884: 358; Finlay, 1926: 349, 369; Wenz, 1938: 312, fig. 694; Powell, 1979: 58, pl. 17, fig. 2.
Anthora tiarata.- Hutton, 1880: 94; Hutton, 1882: 165, pl. 7, fig. n.
Anthora conica Hutton, 1883b: 411.
Trochus conicus.- Hutton, 1893: 68, pl. 8, fig. 73a, b.
Trochus chathamensis.- Hutton, 1893: 69, pl. 8, fig. 74a-c (not Hutton, 1873).
Trochus (Infundibulum) tiaratus.- Suter, 1897: 260; Suter, 1913: 109, pl. 39, fig. 2.
Chlorostoma (Neozelandia) huttoni Cossmann, 1918: 220, pl. 7, fig. 35, 36. Replacement name for *Trochus conica* (Hutton, 1883) not Donovan, 1804.
Trochus huttoni.- Finlay, 1924: 99.
Trochus (Coelotrochus) huttoni.- Finlay, 1926: 349, 369; Powell, 1946: 64; Powell, 1957: 86; Powell, 1962: 78.
Coelotrochus huttoni.- Finlay, 1928: 237.

Type data:
Trochus tiaratus: Lectotype (the originally figured specimen here selected 15.5 x 17.5 mm) and 7 paralectotypes MNHN, "Nouvelle Zélande";
Polydonta elegans: Lectotype (here selected 15.0 x 18.0 mm) BMNH 1996020/1 and 5 paralectotypes BMNH1996020/2-6, "New Zealand";
Trochus delicatulus: Repository unknown, "Oceano Pacifico";
Anthora conica: Holotype Canterbury Museum, Christchurch M2746, Wanganui (Pleistocene).

Other material examined: Several thousand specimens in 100 lots NMNZ.

Distribution: (Fig. 12). Pleistocene (Castlecliffian) to Recent: North, South and Stewart islands, New Zealand, 0-220 m; taken alive at low tide to 40 m on hard or soft substrata.

Remarks: Among New Zealand *Trochus* and *Thoristella* species, *Trochus tiaratus* is characterised by large size (width up to 21 mm), weakly convex teleoconch whorls, gradate spire, non-stellate periphery, finely nodular spiral cords, crowded axial lamellae, deep umbilicus, and lack of umbilical spiral cords. The shell is typically wider than high, occasionally slightly higher than wide. The shell is typically variably spotted and/or irregularly axially banded brown on a paler or white ground, or the last few whorls may be rather uniform brown with paler spots. The few specimens seen from Fiordland (Dusky Sound, empty shells from mud, 15 m, NMNZ M.58940) are unusual in being very darkly

pigmented (stained?) and in that the adapical spiral on the earliest teleoconch whorls vanishes at an early stage of growth so that there are only three primary spiral cords above the peripheral pair (Fig. 3). On the penultimate whorl in adults from elsewhere there are typically four or five primary spiral cords above the peripheral pair, the latter typically surmounting a peripheral bulge, with the addition of varying numbers of secondary spirals that multiply by intercalation.

T. tiaratus evidently originated from the more finely sculptured Late Pliocene (Nukumaruan) species *Coelotrochus browni* Fleming, 1943. The Early Miocene (Altonian) species *Thoristella fossilis* Finlay, 1926 (originally interpreted as a subspecies of *T. chathamensis*), is much closer to *T. browni* and *T. tiaratus* than to any living species of *Thoristella*, and is here referred to *Trochus (Coelotrochus)*. Another member of the same lineage is *Trochus bibaphus* Bartrum and Powell, 1928 (Early Pliocene, Opoitian).

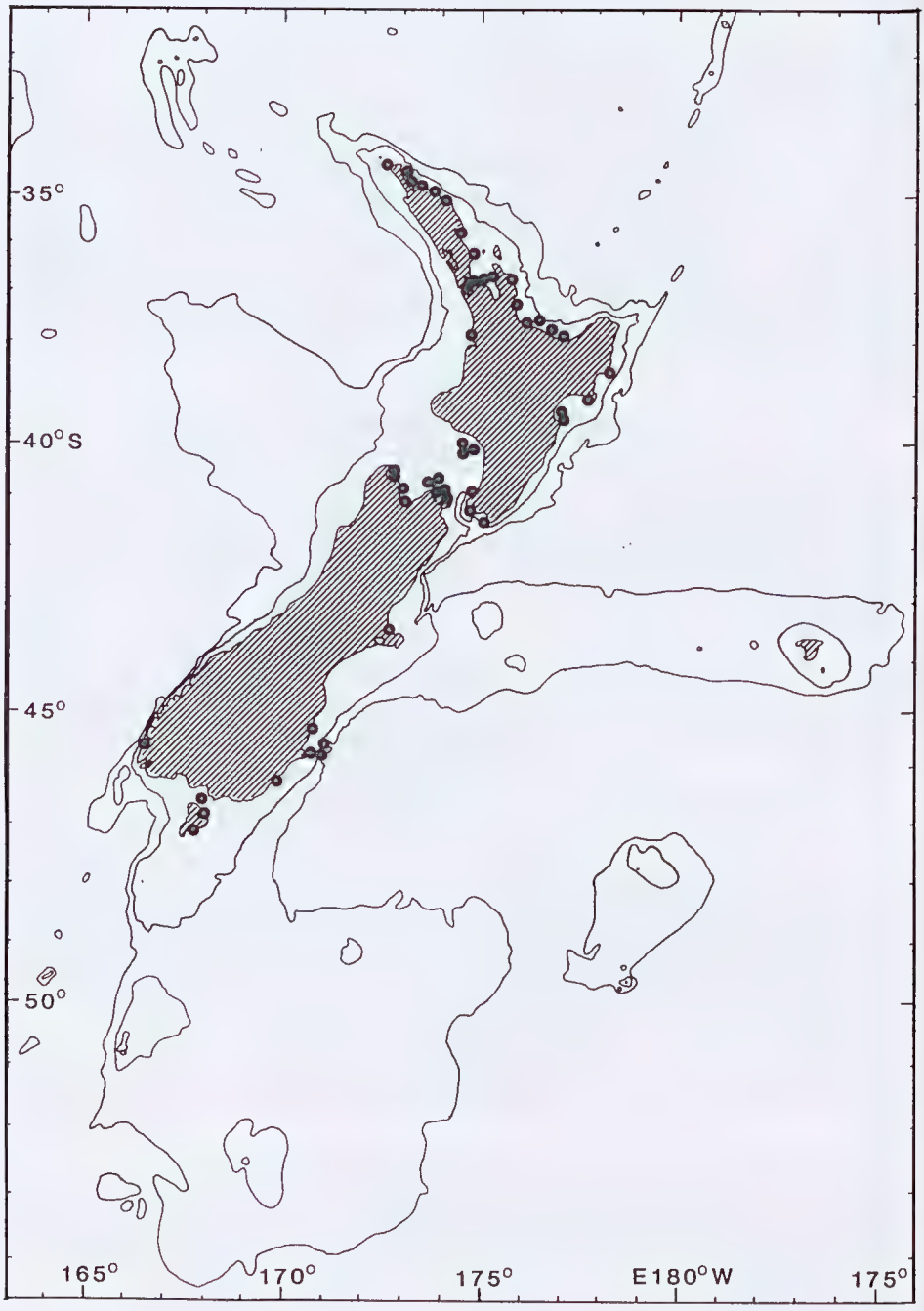
Subgenus **Thorista** Iredale, 1915

Anthora Gray, 1857: 148.
Type species (by monotypy): *Polydonta tuberculata* Gray, 1843 = *Trochus viridis* Gmelin, 1791; Recent, New Zealand. Not *Anthora* Doubleday, 1844.
Thorista Iredale, 1915: 436. Replacement name for *Anthora* Gray, 1857, not Doubleday, 1844.

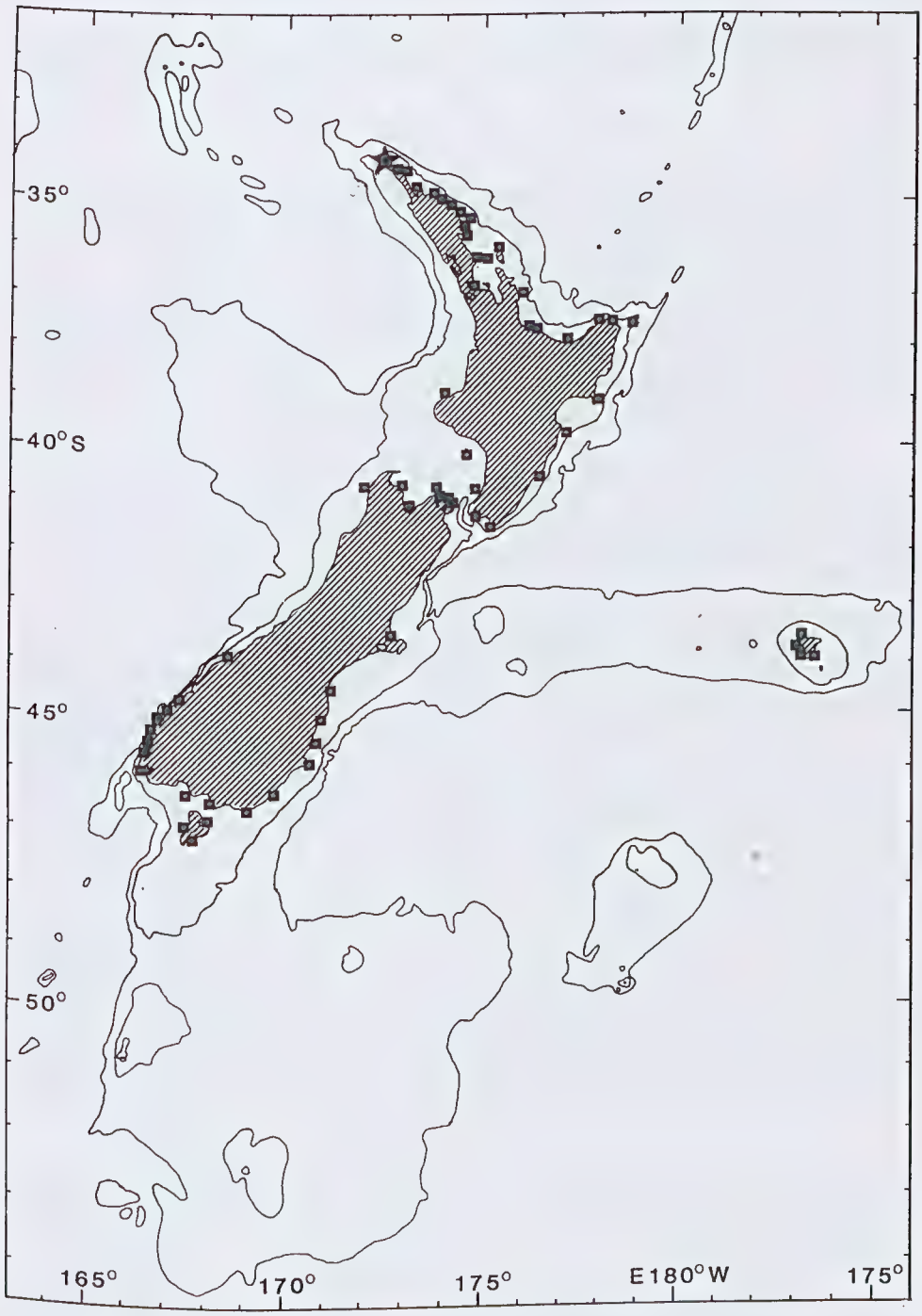
Remarks: The type species of *Thorista* Iredale, 1915 has a stellate periphery, two umbilical spiral cords in adults, and axial lamellae that are intermediate in development between those in *Trochus maculatus* and *T. tiaratus*.

Trochus (Thorista) viridis (Gmelin, 1791)
(Figs 5-8, 10, 11, 13)

Chemnitz, 1781: 97, figs. 1643, 1644.
Trochus viridis Gmelin, 1791: 3572 (based on Chemnitz, 1781, figs 1643, 1644); Philippi, 1848: 47, pl. 10, fig. 9, 10, pl. 16, fig. 7-9; Reeve, 1861: pl. 14, fig. 79a, b; Hutton, 1873: 35; Fischer, 1878: 305, pl. 97, fig. 2; Pilsbry, 1889: 43, pl. 3, fig. 16, 17; Hutton, 1884: 358; Cernohorsky, 1974: 148, fig. 5.
Polydonta tuberculata Gray, 1843: 239; Hutton, 1873: 36;
Trochus acinosus Gould, 1849: 92; Gould, 1852: 179, fig. 217a-c.
Polydonta viridescens A. Adams, 1853: 154 (based on Chemnitz, 1781, figs 1643, 1644).
Trochus fulvolabris Hombron and Jacquinot, 1854: 56, pl. 14, fig. 14, 16.
Polydonta (Infundibulum) tritonis A. Adams, 1855: 132.
Anthora tuberculata - Gray, 1857: 148; Hutton, 1878: 31; Hutton, 1880: 93; Hutton, 1883a: 124, pl. 14, fig. k.
Trochus (Anthora) tuberculatus.- Smith, 1874: 4, pl. 1, fig. 6.
Anthora viridis.- Hutton, 1880: 94.
Anthora tritonis.- Hutton, 1880: 94.
Trochus (Anthora) viridis.- Hutton, 1884: 358.
Trochus (Infundibulum) viridis.- Suter, 1897: 261; Suter, 1913: 110, pl. 8, fig. 9.



Figures 12
Map of New Zealand region showing distributions of *Trochus* and *Thoristella* species. 200 and 1000 metre contours indicated. **12.** *Trochus tiaratus* Quoy and Gaimard.



Figures 13.
Map of New Zealand region showing distributions of *Trochus* and *Thoristella* species. 200 and 1000 metre contours indicated. **13.** *Trochus viridis* Gmelin (■), and *Thoristella rex* n. sp. and *T. polychroma* n. sp. (★).

Trochus (Thorista) viridis.- Iredale, 1915: 436; Finlay, 1926: 349, 369; Wenz, 1938: 312, fig. 695; Powell, 1979: 58, pl. 17, fig. 1.
Thorista viridis.- Finlay, 1928: 237.
NOT *Trochus viridis* W. Wood, 1828: 17, pl. 6, fig. 36 = *Diloma subrostrata* (Gray, 1835).

Type data:
Trochus viridis and *Polydonta viridescens*: Lectotype (here designated) the syntype illustrated by Cernohorsky (1974, fig. 5), unlocalised = New Zealand;
Polydonta tuberculata: Holotype BMNH 1842.5.17.92, "New Zealand";
Trochus acinosus: Holotype USNM 5617, "New Zealand";
Trochus fulvolabris: Lectotype (the originally figured specimen here selected, 22 x 20 mm) and 2 paralectotypes MNHN, "Nouvelle-Zélande";
Polydonta tritonis: Lectotype (here selected, 23.0 x 22.5 mm) BMNH 1961148/1 and 2 paralectotypes BMNH 1961148/2-3, "New Zealand".

Other material examined: >500 specimens in 132 lots NMNZ.

Distribution: (Fig. 13). Late Pliocene (Nukumaruan)?, Pleistocene (Castlecliffian) to Recent: North, South, Stewart and Chatham Islands, New Zealand, 0-83m; taken alive intertidally to 64 m from hard substrata.

Remarks: *Trochus viridis* is characterised by large size (height up 28 mm), stellate periphery, two spiral cords on the umbilical wall, and distinctive sculpture of spiral threads, and interstitial axial lamellae with the addition on the spire of four rows (including periphery) of strong rounded nodules. A fifth row of nodules may appear between the peripheral and adjacent spire spiral on the last whorl in adults. The peripheral nodules commence near the start of the fourth teleoconch whorl and rapidly enlarge, the three adapical rows of nodules enlarge more slowly to eventually resemble the peripheral ones. The shell may be higher than wide or wider than high at maturity. The spire in subadult specimens is evenly conical or weakly coeloconoid, becoming cyrtoconoid at maturity. The peripheral flange becomes moderate to strong in subadult specimens then typically weakens and is absent from the last one or two whorls in adults. The peripheral flange persists onto the last adult whorl on specimens from the south-eastern South Island and Stewart Island (Fig. 8), and is exceptionally strong and persistent on specimens from the Chatham Islands, which also attain the largest size. Specimens from Lyttelton and Timaru are more finely nodular than those from elsewhere in the country (Fig. 7).

This or a closely similar species is known by a fragmentary specimen from the Nukumaru Brown Sands, Wanganui (Late Pliocene, Nukumaruan) (NMNZ M.127390).

The syntypes of *Trochus fulvolabris* Hombron and Jacquinot, 1854, are closely accordant with specimens from Lyttelton, and they were probably obtained there or at nearby Akaroa, which was visited by the Astrolabe in 1840. Not having seen the specimens first hand, I am unable to suggest where in New Zealand the type specimens of *T. viridis* might have come from, though they were certainly not from the Chatham Islands or Stewart Island.

From examination of the holotype (BMNH 196705), *Trochus viridis* W. Wood, 1828 (Wood, 1828, p. 17, pl. 6, fig. 36) is the New Zealand species *Diloma subrostrata* (Gray, 1835). Although this overlooked synonym has seniority, Gray's name must stand as Wood's is preoccupied by that of Gmelin, 1791.

Camelotrochus n. subgen. (of **Trochus**)

Type species: *Trochus camelophorus* Webster, 1906; Recent, northern New Zealand.

Diagnosis: Spire whorls sculptured with strong spiral cords crossed by strong imbricating axial lamellae, periphery not stellate. Umbilical wall with strong spiral cord.

Description: As for the type species (see below).

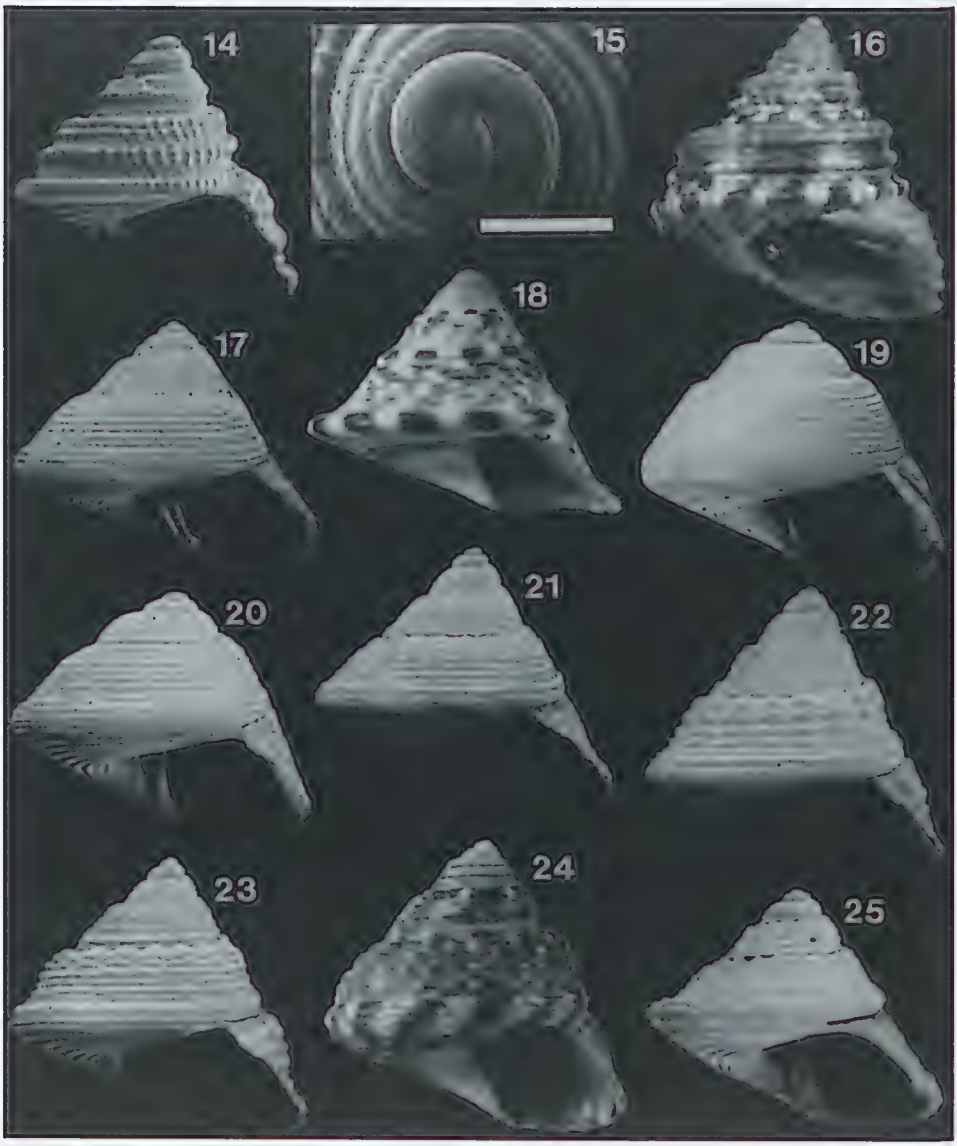
Remarks: *Trochus camelophorus* is characterised by a unique combination of characters and character states *(Diagnosis)*, and cannot be grouped in any genus group within Trochidae. It resembles the type species of *Thorista* and species of *Trochus* Linnaeus, 1758 in having a spiral cord on the umbilical wall, but differs in having fewer spiral cords on the spire, and stronger imbricating axial lamellae that entirely traverse the spire whorls, including the summits of the spiral cords. The spiral cords on the spire in *Thorista* and *Trochus* species have rounded nodules, and axial lamellae (where present) are finer, more crowded and confined to the spiral interspaces.

Etymology: From the Greek *kamilos* (rope) and the generic name *Trochus*

Trochus (Camelotrochus) camelophorus (Webster, 1906)
(Figs 14-16, 38)

Trochus camelophorus Webster, 1906: 309, pl. 39, fig. 1, 1a
Trochus conus.- Suter, 1906: 323 (not Gmelin, 1791).
Trochus (Infundibulum) camelophorus.- Suter, 1913: 110, pl. 33, fig. 3.
Trochus (Thorista) camelophorus.- Iredale, 1915: 436; Finlay, 1926: 369; Powell, 1979: 58, pl. 17, fig. 3.

Description: Shell up to 13 mm wide, about as wide as high, rather evenly conical, umbilicus filled by columella that is inserted on umbilical wall. Protoconch white. First 1.5 teleoconch whorls traversed by evenly spaced arcuate axial bands on pinkish white ground. Subsequent whorls with irregular axial maculations on white or pinkish white ground, maculations predominantly pink or red, some or all maculations on occasional specimens brown, or olive on and between median 2 spire spirals and pink or red above and below them; adult base white or cream, basal spiral cords spotted red or brown. Umbilicus porcellanous white or with a pinkish flush.



Figures 14-25.
Shells of *Trochus* and *Thoristella* species. **14-16.** *Trochus camelophorus* Webster. 14 (juvenile),15 (protoconch). Southeast Bay, Great Island, Three Kings Islands, 55 m, M.33835 (3.50 x 3.90 mm). **16.** Cape Maria van Diemen, beach, M.131604 (9.50 x 9.00 mm). **17-25.** *Thoristella chathamensis* (Hutton). **17.** Kaingaroa, Chatham Islands, littoral, M.12418 (4.60 x 6.30 mm). **18.** Chatham Islands, beach, M.16387 (6.10 x 8.25 mm). **19.** Kapiti Island, littoral, M.7114 (3.90 x 4.95 mm). **20.** Two Thumb Bay, Fiordland, 15 m, M.127294 (3.65 x 4.70 mm). **21.** Dusky Sound, Fiordland, 55m, M.10053 (5.00 x 5.80 mm). **22.** Off Otago Heads, 220 m, M.66845 (5.20 x 5.60 mm). **23.** Nugget, Halfmoon Bay, Stewart Island, littoral, M.64613 (5.90 x 6.75 mm). **24.** Golden Bay, Stewart Island, littoral, M.64176 (7.20 x 7.75 mm). **25.** Easy Harbour, Stewart Island, 7-20 m, M.27124 (4.40 x 5.50mm). Scale bar 15 = 330 μm.

Protoconch 350 μm wide, smooth, tip tightly pinched. Teleoconch of up to 6 whorls, periphery angulate, whorls inserted against base of peripheral spiral, base weakly convex, sculptured with rounded spiral cords and imbricating collabral axial lamellae. First 1.5 whorls convex, next whorl medially angulate, subsequent whorls flat-sided below concave subsutural ramp. Spire with 5 primary spiral cords that commence immediately, abapical 2 coalescing on third whorl, becoming fully fused on fourth whorl to form peripheral spiral, which is broadest, others similar to each other; 2 secondary spirals appearing on penultimate or last adult whorls in interspaces of abapical 3; 6 or 7 on base narrower than on spire, narrower towards umbilicus. Spire spirals smooth, similar and regularly spaced on first 2 whorls; on third whorl becoming nodular then lamellate with appearance of axial sculpture, and abapical third spiral descending abapically, adapical 2 spirals thereafter closest throughout. Axial lamellae commencing on third whorl, entirely traversing spirals and interspaces, strong on spire, much finer and more crowded on base. Umbilicus invaded by columella, rim undercut; wall with single, strong, smooth spiral cord, summit flattened, medially grooved in some specimens, outer side undercut, inner side almost vertical; deeply concave between cord and rim and cord and columella. Columella thick, strongly so adapically, oblique, protracted from insertion to low rounded adapical swelling, straight abapically. Aperture subtrapezoidal, simple; outer lip thin at rim, thickened within, strongly so abapically; parietal inductura thick at maturity.

Type data: Holotype AIM AK70776, Cape Maria van Diemen, beach drift.

Other material examined: 126 specimens in 23 lots NMNZ.

Distribution: (Fig. 38). Off Three Kings Islands, Cape Maria van Diemen, Whangaroa, off White Island, and Ranfurly Bank, East Cape, northern New Zealand, 0-228 m; taken alive at 50-76 m on Ranfurly Bank, East Cape (71-76 m, 1 live juvenile with 40 empty shells, NMNZ M.127364; 50-72 m, 1 subadult M.96247). Precise habitat unknown though certainly rocky ground and probably deep under boulders.

Remarks: *Trochus (Camelotrochus) camelophorus* is highly distinctive in its strong spiral sculpture, the relatively strong imbricating axial lamellae, and the single strong spiral cord within the umbilicus.

Genus **Thoristella** Iredale, 1915

Thoristella Iredale, 1915: 436.
Type species (by original designation): *Polydonta chathamensis* Hutton, 1873; Recent, New Zealand.

Remarks: Species of *Thoristella* attain smaller shell size (width up to 11mm) and have relatively larger cephalic tentacles than the type species of *Trochus*, *Coelotrochus* and *Thorista*, lack umbilical spiral cords, and have axial lamellae

similar to those in *T. viridis*. The periphery varies in shape from stellate to non-stellate in the type species, but is never stellate in the others. The strong similarity between adult *Thoristella chathamensis* and juvenile *Trochus (Thorista) viridis*, suggests close relationship between *Thoristella* and *Thorista*, and that one group is derived from the other by a paedomorphic process (polarity unclear). Note in this respect that the first umbilical spiral cord in *Trochus (Thorista) viridis* does not commence until the shell is about 10mm wide, suggesting that cord development in adult *Thoristella* species is retarded. The earliest known representative is an unnamed Early Miocene (Waitakian) species from Brydone, Southland reported by Beu and Maxwell (1990), and the group is endemic to New Zealand. The protoconch in all but one of the *Thoristella* species has a tightly pinched tip as in *Trochus (Thorista) viridis* and *T. (Coelotrochus) tiaratus*, the exception being *T. polychroma* n. sp., which has a bulbous tip.

Thoristella crassicosta Powell, 1937, from off the Three Kings Islands, is type species of *Acremodonta* B.A. Marshall, 1983, and belongs in Trochaclididae Thiele, 1929 (Hickman and McLean, 1990; Marshall, 1983, 1995). *Thoristella chathamensis profunda* Dell, 1956 is based on juveniles of the calliostomatid *Calliostoma (Maurea) blacki* (Powell, 1950) (Marshall, 1995).

Thoristella chathamensis (Hutton, 1873)
(Figs 17-30, 35-37, 39)

Polydonta chathamensis Hutton, 1873: 36
Anthora chathamiensis [sic].- Hutton, 1878: 31
Anthora chathamensis.- Hutton, 1880: 94.
Trochus (Coelotrochus) chathamensis.- Hutton, 1884: 359.
Trochus chathamensis.- Pilsbry, 1889: 43; Suter, 1897: 260.
Trochus (Infundibulum) oppressus.- Suter, 1897: 261 (in part).
Trochus (Infundibulum) oppressus dunedinensis Suter, 1897: 261. New synonym.
Calliostoma aucklandicum Smith, 1902: 207, pl. 24, fig. 5; Suter, 1913: 144, pl. 33, fig. 15. New synonym.
Trochus (Infundibulum) chathamensis.- Suter, 1913: 107, pl. 33, fig. 2.
Trochus (Infundibulum) chathamensis dunedinensis.- Suter, 1913: 108.
Thoristella chathamensis.- Iredale, 1915: 436; Odhner, 1924: 12; Finlay, 1928: 237.
Thoristella chathamensis dunedinensis.- Iredale, 1915: 436; Finlay, 1926: 351, 370, pl. 18, fig. 15, 16; Powell, 1955: 51; Powell, 1979: 59.
Thoristella aucklandica.- Iredale, 1915: 436; Odhner, 1924: 12.
Thoristella chathamensis benthicola Finlay, 1926: 350, 370; Cernohorsky, 1972: 236, fig. 7.
Thoristella chathamensis chathamensis.- Finlay, 1926: 370; Powell, 1979: 59, pl. 17, fig. 16.
Thoristella chathamensis aucklandica.- Finlay, 1926: 370; Powell, 1933: 35; Powell, 1955: 50; Powell, 1979: 59, pl. 17, fig. 7.
Thoristella chathamensis cookiana Powell, 1934: 154, pl. 22, fig. 10, 11. New synonym.
NOT *Trochus chathamensis*.- Hutton, 1893: 69, pl. 8, fig. 74a-c = *Trochus tiaratus* Quoy and Gaimard, 1834.

Description (Chatham Islands material only): Shell up to 9.2 mm wide, as wide or (typically) wider than high, thick, conical, spire weakly gradate or pagodiform, base of narrow umbilicus infilled with callous. Colour: protoconch white; first 2 teleoconch whorls cream with 3 narrow, red spiral bands, abapical band partly covered by succeeding whorls, median spiral alone persisting onto third whorl and remaining red or becoming olive or brown; third and subsequent whorls greenish white or white with olive or brown (fading to red in beach shells) irregular axial maculations and spots, peripheral bulge alternately maculated, basal spirals alternately streaked; umbilicus and columella porcellanous white. Protoconch 300 μm wide, smooth, tip tightly pinched. Teleoconch of up to 5 whorls, first 2 whorls convex, subsequent whorls becoming weakly convex or almost flat above peripheral bulge; periphery tightly rounded; peripheral bulge varying from very weak to strong and flange-like, summit smooth or gently undulant, whorls inserted against its abapical side; base weakly convex. Spire and base sculptured throughout with narrow, smooth spiral cords, and fine, crisp, crowded, interstitial collabral lamellae; last few spire whorls with or without addition of low, broad, rounded axial folds on adapical half. Spiral cords multiplying by intercalation, numbering 12-14 on adult penultimate whorl, summits more or less flat. Umbilical wall smooth. Columella thick, smooth, almost straight, inserted against rim of umbilicus. Aperture trapezoidal. Outer lip simple, rim thin, thickened within, strongly thickened abapically.

Type data:
Polydonta chathamensis: Original type material lost (Marshall, 1996), type locality Chatham Islands;
Trochus oppressus dunedinensis: Lectotype (Boreham, 1959) NZGS TM434, Dunedin Harbour, under stones;
Calliostoma aucklandicum: Lectotype (the originally figured syntype here selected, 7.50 x 8.00 mm) BMNH 1902.5.16.90 and 5 paralectotypes BMNH 1902.5.16.91-95, Auckland Islands, 18 m;
Thoristella chathamensis benthicola: Holotype AIM TM70764, off Otago Heads, 110m;
Thoristella chathamensis cookiana: Holotype AIM AK70765, Island Bay, Wellington, under stones.

Other material examined: About 1000 specimens in 110 lots NMNZ.

Distribution: (Fig. 39). Southern North Island, South Island east coast, Fiordland, and Stewart, Snares, Auckland, Campbell, Antipodes, Bounty and Chatham Islands, southern New Zealand, 0-360 m; taken alive at low tide (under stones) to 100 m on hard substrata.

Remarks: Thoristella chathamensis is the most variable trochid living in the New Zealand region. Teleoconch sculpture consists of fine to strong spiral cords that number eight to fourteen on the adult penultimate whorl (including abapical spiral, summit of which is more or less covered by succeeding whorls); fine, crowded to strong and well-spaced interstitial collabral lamellae; with or without the addition of weak to strong rounded axial folds on the spire.

Specimens from the littoral and shallow sublittoral tend to be more broadly conical, and to have finer, more numerous spiral cords, finer and closer axial lamellae, and weaker axial costae (or none) than specimens from deeper water. The colour pattern may comprise spiral bands on the first two teleoconch whorls and irregular axial maculations, spots and spiral streaks thereafter, or solid spiral bands throughout. The shell ranges from slightly higher to (typically) markedly wider than high, and the periphery may be simply angulate or very prominently flanged. There is complete intergradation between the extremes both within many populations and from one population to another. Adult specimens range from 4.70 to 10.0 mm in width (Stewart Island), the largest specimens seen being from Stewart Island and the Auckland Islands (width up to 10.0 mm).

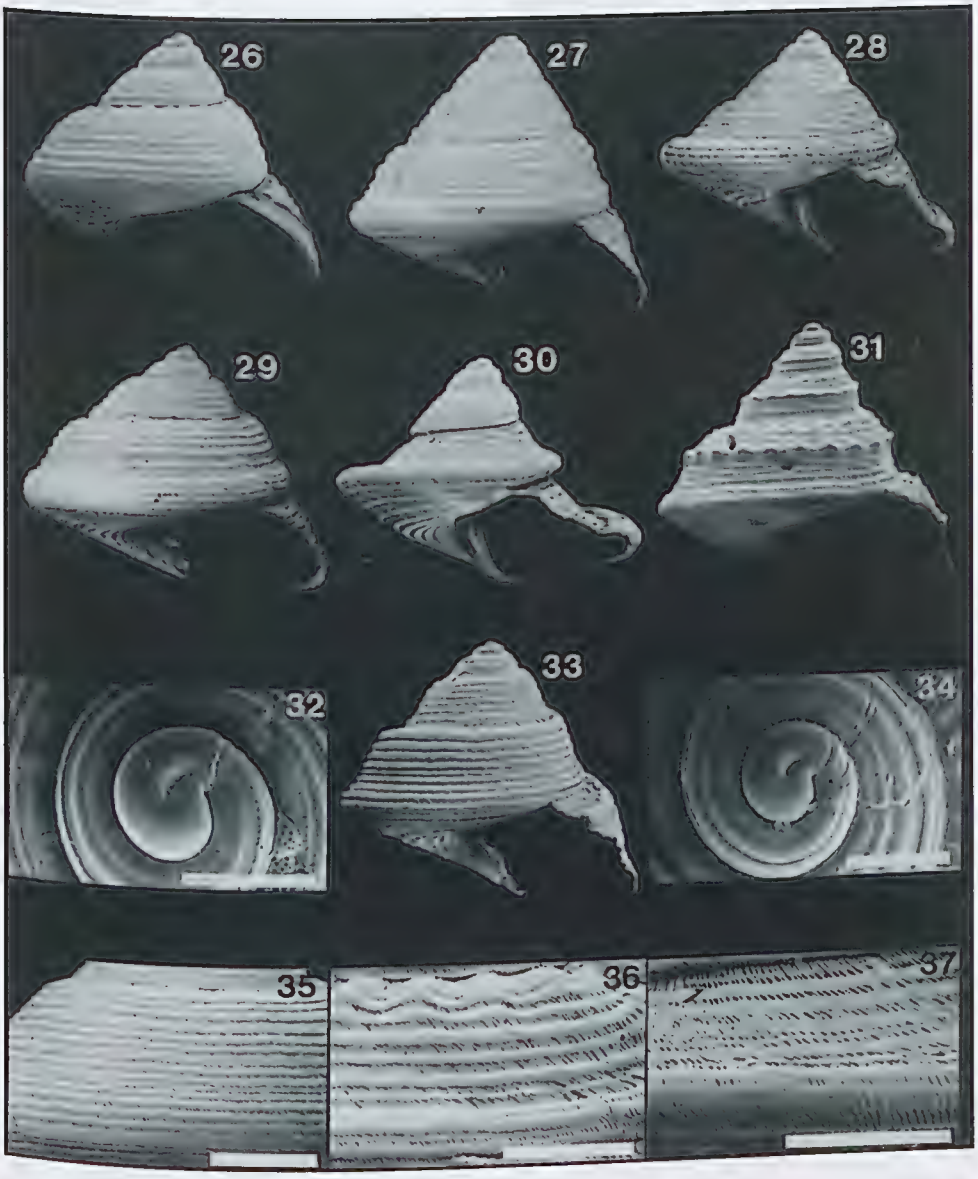
Specimens from the Chatham Islands have the strongest axial colour patterns and simple to strongly flanged peripheries, and the axial costae are weak or absent (Figs 17, 18).

The most stable isolated population occurs off the Bounty Islands, where the species is abundant. All of these shells lack axial folds, and are low, unusually small (width up to 5.7 mm), and spirally banded, with an exceptionally strong, upturned peripheral flange on the last adult whorl (Figs 30, 37).

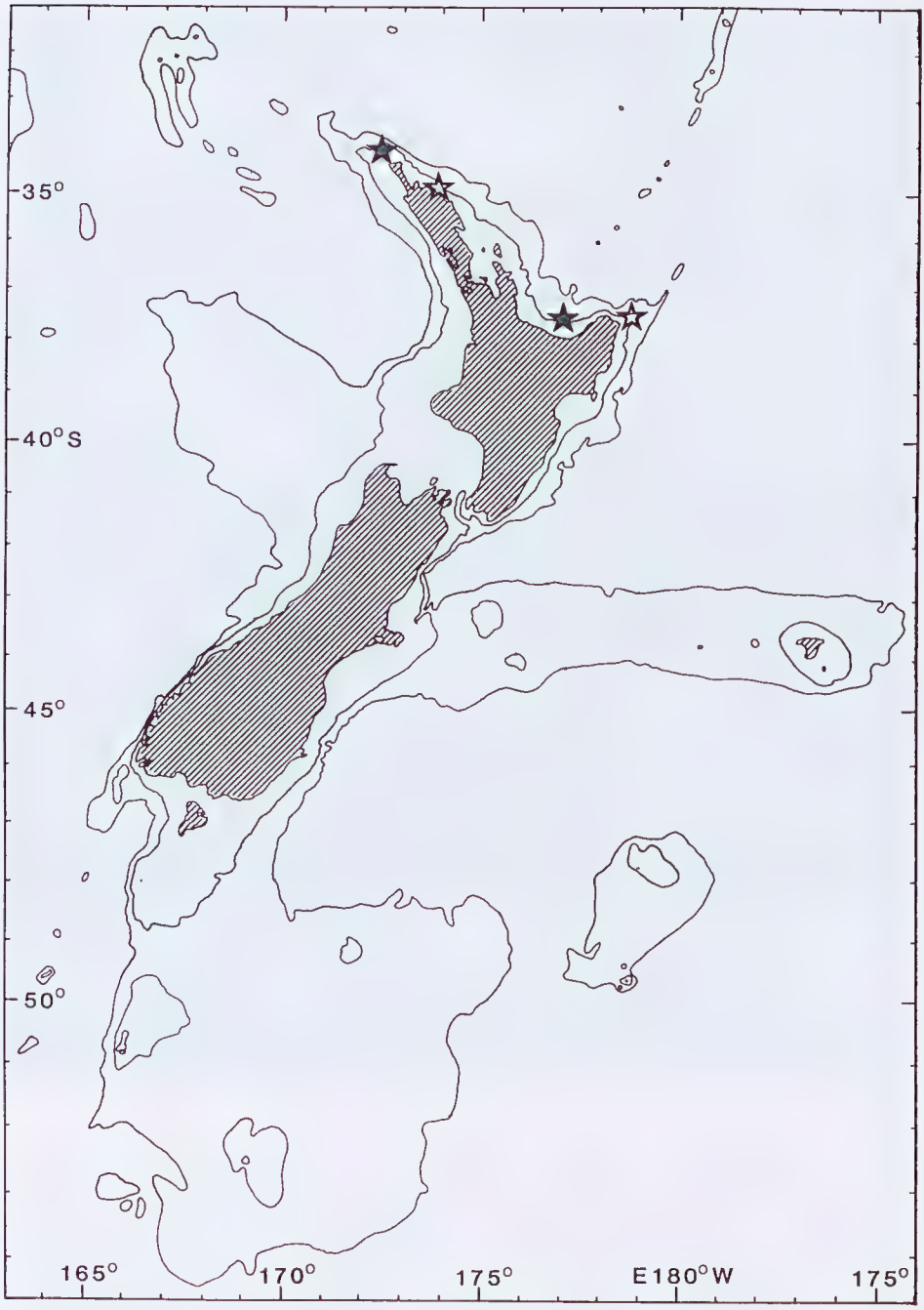
Specimens from the Antipodes Islands are spirally banded, have moderate peripheral bulges and weak axial folds, and are similar to Auckland Islands shells (Fig. 29).

Specimens taken living from the littoral zone and as beach shells at the Auckland Islands (Figs 26-30) resemble the Bounty Islands form in colour and colour pattern, but the peripheral bulge is not as prominent though moderate to strong, and axial costae may be present or absent. Specimens taken there by dredging have higher spires, and weak to moderate peripheral bulges, most having stronger axial costae though some lack them (Fig. 28). The few (littoral) specimens seen from Campbell Island resemble Auckland Islands shells, and all have axial costae and a moderate peripheral bulge.

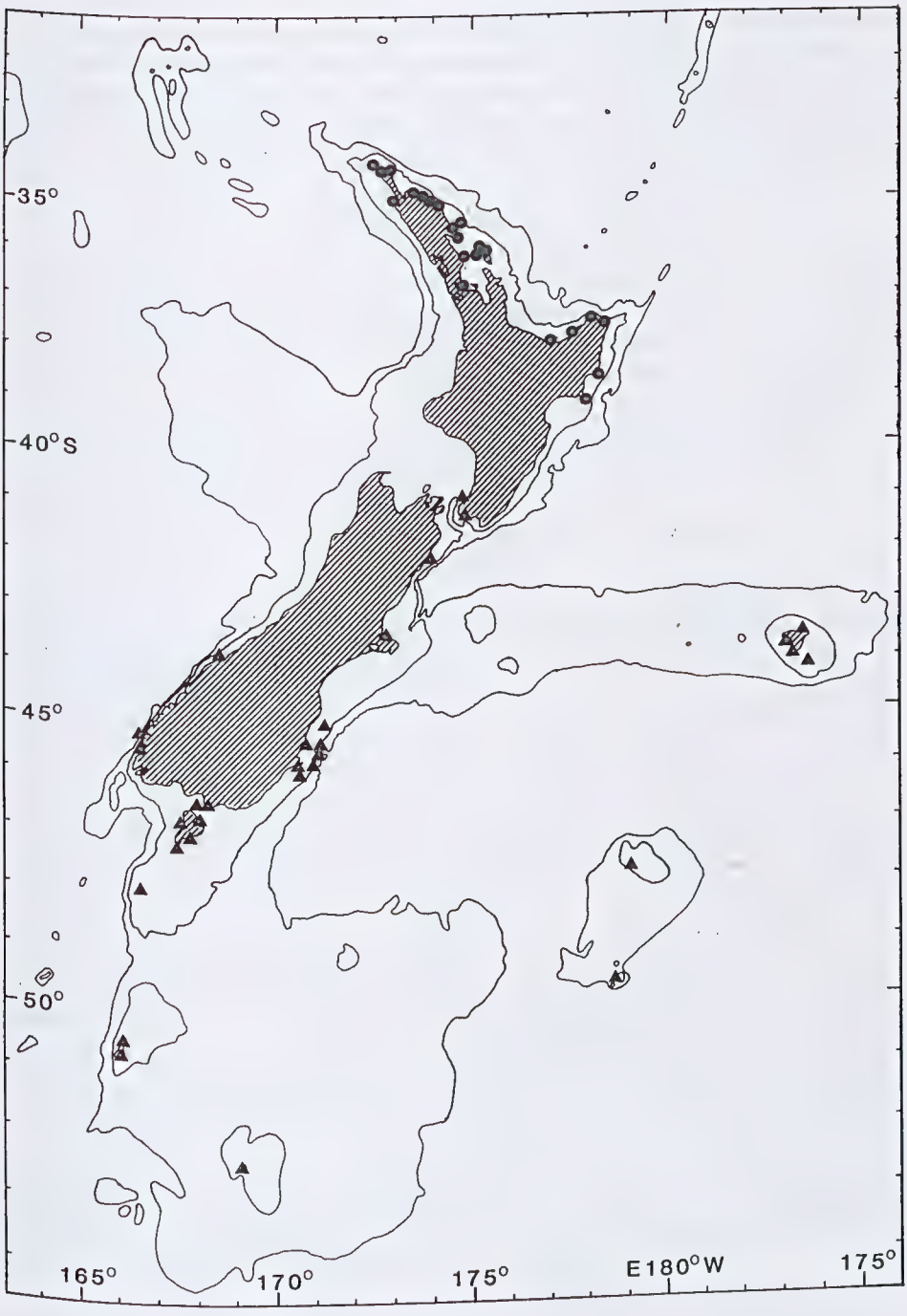
All specimens seen from the southern North Island, including the holotype of *T. chathamensis cookiana,* lack axial costae (Fig. 19), and this is the characteristic littoral and shallow sublittoral form from the South Island east coast, Fiordland, Stewart Island, and the Chatham Islands. A weakly costate form occurs in the littoral at Shag Point, Otago, and *T. chathamensis dunedinensis* is based on weakly and non-costate littoral specimens from Dunedin. The most strongly costate forms occur living at 33-100 m off Otago Peninsula, in Foveaux Strait, and off Stewart Island, and include the holotype of *T. chathamensis benthicola* (Fig. 22). There is complete intergradation between costate and non-costate extremes in extensive collections from Fiordland, and Stewart, Snares, Auckland and Chatham Islands, and between specimens with flanged and simple peripheries in Fiordland and off Otago and Snares, Auckland, and Chatham islands. Powell (1955) considered that all specimens from Bounty, Auckland and Campbell islands were consubspecific (*T. chathamensis aucklandica*). There seems to be little doubt, however, that all of the material examined represents a single highly polymorphic species.



Figures 26-37.
Shells of *Thoristella* species. **26-30.** *T. chathamensis* (Hutton). **26.** Laurie Harbour, Auckland Islands, 7 m, M.45297 (5.40 x 6.30 mm). **27.** Tagua Bay, Auckland Islands, 18m, M.8369 (7.20 x 7.80 mm). **28.** Derry Castle Reef, Enderby Island, Auckland Islands, beach, M.49632 (4.05 x 5.80 mm). **29.** Ringdove Bay, Antipodes Islands, M.29188 (6.00 x 7.60 mm). **30.** Off Proclamation Island, Bounty Islands, 39 m, M.119722 (3.50 x 4.85 mm). **31, 32.** *T. rex* n. sp., off Northeast Island, Three Kings Islands, 102 m. **31.** Holotype, M.127365 (4.25 x 4.90 mm). **32.** Protoconch of paratype M.34257. **33,34.** *Thoristella oppressa* (Hutton). **33.** Taurikura Bay, Whangarei Heads, littoral, M.18871 (4.55 x 5.30 mm). **34.** (protoconch). N of Cape Reinga, 88 m, M.35911. **35-37.** *Thoristella chathamensis*, details of teleoconch sculpture of specimens at Figures 19, 25 and 30 respectively. Scale bars 32, 34 = 330 μm, others = 1 mm.



Figures 38.
Map of New Zealand region showing distributions of *Trochus* and *Thoristella* species. 200 and 1000 metre contours indicated. **38.** *Trochus camelophorus* (☆ and ★) and *Thoristella carinata* n. sp. (★).



Figures 39.
Map of New Zealand region showing distributions of *Trochus* and *Thoristella* species. 200 and 1000 metre contours indicated. **39.** *Thoristella oppressa* (Hutton) (l) and *Thoristella chathamensis* (Hutton) (▲).

Despite ranging as far north as the southern North Island, and being common living to 100 m depth off Otago Peninsula, *T. chathamensis* has not been obtained living sublittorally north of Oamaru, despite extensive sampling of seemingly favourable substrata. Why it does not isotherm track sublittorally in the northernmost part of its range is unclear. It is the only *Thoristella* species occurring south of Cook Strait. Shells of this species are commonly encrusted with sabellid polychaetes of the genus *Spirorbis*.

Colonial Museum (now Museum of New Zealand) lot 193, listed by Hamilton (1906) as "Chatham Islands (Types?)", is no longer extant (Marshall, 1996). The only other early specimens remaining in the collection are six shells labelled "N.Z. Coll. A. Hamilton" that had originally been gummed to a tablet (NMNZ M.515). The original label is no longer extant. According to Hamilton (1906), this material was added to the collection after 1904 so they cannot be type specimens.

Thoristella chathamensis profunda Dell, 1956 is based on juveniles of the calliostomatid *Calliostoma (Maurea) blacki* (Powell, 1950) (Marshall, 1995).

Thoristella rex n. sp.
(Figs 13, 31, 32)

Description: Shell up to 5.00 mm wide, slightly wider than high, of moderate thickness, umbilicus narrow. Colour: Protoconch translucent white; spire on first 1.5 teleoconch whorls traversed by regular, arcuate pink bands on white or pinkish white ground; subsequent spire and base pink or pale olive, irregularly axially banded and spotted white; umbilicus porcellanous white. Protoconch 330 μm wide, smooth, tip tightly pinched. Teleoconch of up to 4.5 whorls, periphery angulate, base weakly convex. First 1.5 whorls convex, subsequent spire whorls with median nodular angulation and tightly rounded, weakly undulant peripheral bulge. Sculpture consisting of spiral cords that multiply by intercalation, low, rounded axial pleats in narrow subsutural zone, and fine, crisp, crowded, interstitial axial riblets. Spiral cords crisp, narrow, interspaces wider, abapical spiral partly covered by succeeding whorls; 4 on first spire whorl, smooth, similar; multiplying to 9 on subsequent whorls, median and (in holotype) subsutural spiral becoming nodular; 10 smooth, similar cords on base, another on outer part of smooth, concave umbilicus (holotype). Columella thick, strongly so adapically before retracting to insertion. Outer lip simple, thin at rim, thickened within, strongly so abapically. Animal unknown.

Type data: Holotype NMNZ M.127365 and 5 immature paratypes NMNZ M.34257, 34°08.5'S, 172°11'E, off Northeast Island, Three Kings Islands, dead, 102 m, 18 February 1974, r.v. Acheron. Paratype: 33°59.9'S, 171°45.3'E, Middlesex Bank, NW of Three Kings Islands, dead, 186-196 m, 31 January 1981, r.v. Tangaroa (1 subadult, M.127363).
Other material examined: 78633. 34°20.4'S, 171°48.2'E, 37 km SW of Great Island, Three Kings Islands, 440 m, 21 June 1978, r.v. Tangaroa (fragment, M.131601).

Distribution: (Fig. 13). Off Three Kings Islands, northern New Zealand, 102-440 m, from comminuted bryozoan/shell substrata (shells only).

Remarks: Thoristella rex resembles strongly sculptured forms of the type species (*T. chathamensis*) in having a subsutural zone of axial pleats on the teleoconch, but differs from all forms of that species in having axial instead of spiral colour bands on the early teleoconch whorls, and from this and other *Thoristella* species in having a nodular median angulation on the spire. A specimen represented by a fragment of a last adult whorl is estimated to have been 6.9 mm wide, suggesting that the holotype is subadult.

Etymology: King (Latin).

Thoristella oppressa (Hutton, 1878)
(Figs 33, 34, 39)

Gibbula oppressa Hutton, 1878: 34; Pilsbry, 1889: 232, pl. 40, fig. 4, 5; Hutton, 1880: 102; Hutton, 1883a: 124, pl. 14, fig. m; Hutton, 1884: 364.
Trochus (Infundibulum) oppressus.- Suter, 1897: 261 (in part = *T. chathamensis*); Suter, 1913: 108, pl. 38, fig. 2, 2a (in part = *T. chathamensis*).
Thoristella oppressa.- Iredale, 1915: 436; Powell, 1979: 60, pl. 17, fig. 8.
Thoristella chathamensis oppressa.- Finlay, 1926: 370.

Type data: Type material apparently lost, not traced at Otago Museum where it should presumably have been: "Auckland".

Other material examined: Several hundred specimens in 50 lots NMNZ.

Distribution: (Fig. 39). Three Kings Islands (uncommon) and north-eastern North Island (common) as far south as Mahia Peninsula, New Zealand, living under stones and on kelp holdfasts at low tide to 15 m depth, locally living as deep as 88 m (off Cape Reinga, NMNZ M.35911).

Remarks: Compared with shallow water forms of *Thoristella chathamensis* without nodules, which it much resembles, *T. oppressa* differs in that all but the earliest teleoconch whorls are shouldered, in that the spiral cord at the shoulder angulation becomes much broader than the others, and in that early teleoconch whorls are axially instead of spirally banded. Unlike forms of *T. chathamensis*, *T. oppressa* is never nodular or axially costate, and there are no discernible differences between littoral and deep-living populations. The two species are allopatric, with *T. oppressa* unknown south of Mahia Peninsula, and the nearest populations of *T. chathamensis* at Wellington. I am unable to detect any differences in shell morphology colour or colour pattern between specimens from the Three Kings Islands and the North Island.

Suter's (1897, 1913) record of this species from the Chatham Islands is based on the non-costate form of *T. chathamensis*.

Thoristella carmesina (Webster, 1908)
(Figs 40, 41, 43, 48, 60)

Trochus carmesinus Webster, 1908: 256: pl. 20, fig. 16-18.
Monilea carmesina.- Suter, 1913: 140, pl. 38, fig. 24.
Thoristella carmesina.- Finlay, 1926: 350.
Talopena carmesina.- Powell, 1974: 207; Powell, 1979: 60, pl. 17, fig. 11.

Type data: Holotype AIM AK70777, Russell, Bay of Islands.

Other material examined: 60 specimens in 20 lots NMNZ.

Distribution: (Fig. 60). North-eastern North Island, from Whangaroa to as far south as Ranfurly Bank, East Cape, northern New Zealand, 0-228 m, taken alive (by divers) under stones at 12-15 m.

Remarks: *Thoristella carmesina* differs from *T. oppressa* in lacking a shoulder angulation, in attaining larger size (width 8.00mm, cf. 6.80mm), and in having a smaller protoconch (width 300 μm, cf. 330 μm), a deeper umbilicus, weaker interstitial axial lamellae; finer, more numerous, closer spiral threads; and in that there is a shallow channel between the top of the columella and the insertion.

Powell (1974) referred this species to *Talopena* Iredale, 1918 (type species *Monilea incerta* Iredale, 1912; Recent, Kermadec Islands) because of the presence of a flexure in the columella beside the insertion. *Monilea incerta*, however, has strongly dissimilar gross facies, including a deeply perspective umbilicus, and an inner lip that is entirely different in shape and inserted on the paries. I have already indicated (Marshall, 1979) that *M. incerta* has scale-like central and lateral teeth and undoubtedly belongs in Umboniinae, and that *Talopena* may be a synonym of *Monilea* Swainson, 1840. The external anatomy, shell and radular morphology of *T. carmesina* are accordant the non-costate form of *T. chathamensis* and *T. oppressa*, and it is a perfectly typical *Thoristella* species.

Webster's (1908) record of the species from Cape Palliser is presumably based on the *cookiana* form of *T. chathamensis*.

Thoristella davegibbsi n. sp.
(Figs 42, 44, 46, 49, 60)

Description: Shell up to 6.90 mm wide, wider than high, stout, umbilicate. Colour: Protoconch white or pale green; first 1.5 whorls white or greenish white with 3 red spiral bands (abapical band partly covered by succeeding whorl); subsequent spire whorls basically green (typically), red or brown with narrow, paler and darker, wavy, irregular axial bands and spots; predominant colour in some specimens abruptly changing from green to brown or from green to brown to green. Umbilicus and columella porcellaneous white. Interior nacreous, a narrow whitish band immediately within outer lip, rim of which shows external pigmentation. Protoconch 300-320 μm wide, smooth, tip pinched. Teleoconch of up to 4.20 rather regularly expanding whorls, last part of last adult whorl slightly contracted and descending; periphery roundly angulate, weakly bulging; base weakly convex. First 2 spire whorls strongly convex; subsequent whorls weakly convex, almost flat over abapical 2 thirds. Sculpture of numerous

fine, flattened spiral threads and finer, crisp, crowded interstitial collabral lamellae. Wall of umbilicus smooth. Columella thick, smooth, near adapical extremity distinctly and rather suddenly retracted to insertion, straight abapically. Outer lip simple, rim thin; thickened within, more strongly so abapically.

Type data: Holotype NMNZ M.100394, Southeast Bay, Great Island, Three Kings Islands, alive under stones, 18-22 m, May 1988, scuba, D. Gibbs. Paratypes: 33°57.4'S, 172°19.4'E, King Bank, N of Three Kings Islands, dead, 128-123 m, 1 February 1981, r.v. Tangaroa (3, M.72052); 34°10'S, 172°08'E, off Princes Rocks, Three Kings Islands, dead, 14 m, 4 January 1976, scuba, A. Watson (2, M.127355); 34°10'S, 172°08'E, outer Southeast Bay, Great Island, Three Kings Islands, dead, 55 m, 18 February 1974, r.v. Acheron (3, M.33865); Southeast Bay, Great Island, dead, 12 m, 2 February 1993, scuba F. Brook (1, M.117433); SW corner of Southeast Bay, Great Island, alive under stones, 15 m, 21 December 1976, scuba R.C. Willan (4, R.C. Willan colln); reef between Great Island and Farmer Rocks, dead, 33 m, 17 February 1986, scuba, G.S. Hardy (1, M.94041); off N face of Hinemoa Island, Three Kings Islands, dead, 23 m, 11 February 1986, scuba, G.S. Hardy (1, AMS; 35, M.112544); off NE point of Great Island, alive, 4 m, 14 February 1986, scuba F. Brook (1, M.109283); 34°11'S, 172°03'E, off West Island, Three Kings Islands, dead, Elingamite wreck, 37 m, 16 March 1981, airlifter K. Tarlton (5, M.127356); 34°21'S, 172°37'E, N of Cape Reinga, alive, 88 m, 19 February 1974, r.v. Acheron (5, M.59507).

Other material examined: (54 specimens). 35°27'S, 174°44'E, Northern Arch, Te Araara Point, Poor Knights Islands, dead, 50 m, April 1977, scuba, A. Penniket (30, M.127409); 35°28'S, 174°44'E, Middle Arch, Poor Knights Islands, dead, 30 m, 18 June 1981, scuba, K. Burch (1, M.119416); Middle Arch, dead, 15 m, 1 August 1976, A. Penniket (3, R.C. Willan colln). 35°29'S, 174°44'E, Riko Riko Cave, Aorangi Island, Poor Knights Islands, dead, 30 m, 4 February 1980, scuba, A. Penniket (5, M.127417); 35°29'S, 174°44.5'E, South Harbour, Aorangi Island, dead, 25 m, 21 April 1977, scuba, A. Penniket (15, M.127413).

Distribution: (Fig. 60). Off Three Kings Islands, Cape Reinga, and Poor Knights Islands, northern New Zealand, 4-128 m on rocky ground, taken alive at 4-88 m. Specimens taken by divers were living under stones.

Remarks: Compared with *Thoristella carmesina*, which it much resembles, *T. davegibbsi* differs in having spiral instead of axial red colour bands on the first 1.5 teleoconch whorls (Figs 40, 42), slightly but distinctly weaker spiral cords at equivalent stages of growth, and a narrower and shallower umbilicus. *T. davegibbsi* differs further in attaining smaller size (width up to 6.90 mm, cf. 8.00 mm). The basic colour of the spire after the first 1.5 teleoconch whorls in both species is variable, though in *T. davegibbsi* it is green (typically), brown or (rarely) red in specimens from the Three Kings Islands, and brown in most specimens from off the Poor Knights Islands. Equivalent whorls in *T. carmesina* are red, or have a strong red component in their colour patterns.

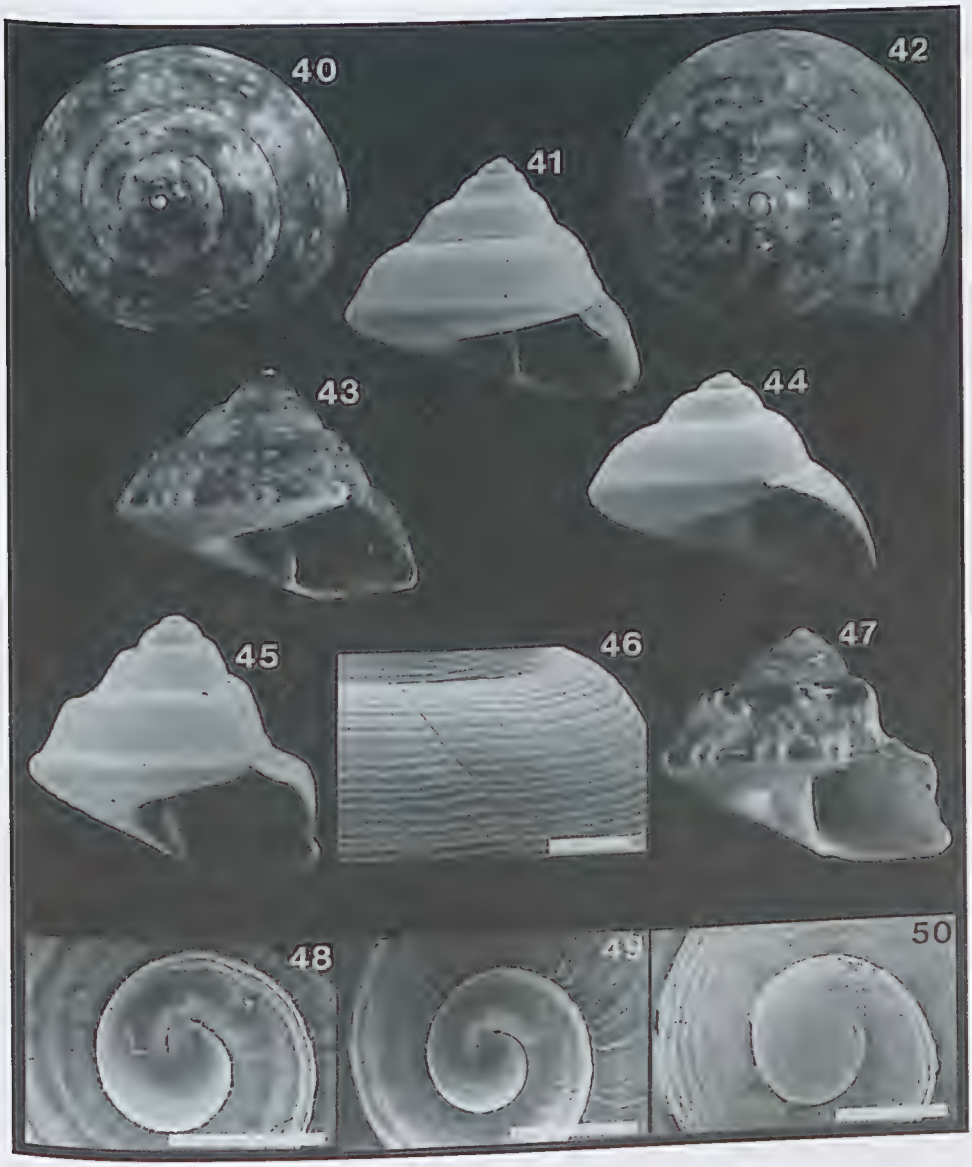
T. davegibbsi and *T. carmesina* appear to be allopatric. *T. carmesina* has not been recorded from the Poor Knights Islands where *T. davegibbsi* is not uncommon, yet *T. carmesina* but not *T. davegibbsi* is recorded elsewhere off the north-eastern North Island. *T. davegibbsi* is the only New Zealand endemic mollusc known with this distribution pattern.

Etymology: Named in honour of the late Dave Gibbs (1954-1995), good friend and outstanding collector.

Thoristella polychroma n. sp.
(Figs 13, 45, 47, 50)

Description: Shell up to 5.95 mm wide, wider than high, rather thick, stout, glossy, narrowly umbilicate. Colour: Protoconch yellow; spire and base on first 1.5 teleoconch whorls pinkish white, traversed by similar, evenly spaced, narrow, arcuate, bright pink collabral bands; subsequent spire whorls with irregular, wavy axial bands between large, irregular subsutural maculations and smaller, irregular peripheral maculations in shades of dull pink or red on a white or (predominantly) greenish white ground. Adult base predominantly creamy white, central part traversed by narrow, pale pink, irregular axial bands, some of which coalesce at inner side of zone. Umbilicus and columella porcellanous white, interior of outer lip rim showing external pigmentation, opaque nacreous white within. Protoconch 430 μm wide, smooth, tip broadly rounded. Teleoconch of up to 4.0 regularly expanding whorls, last part of last adult whorl contracted and descending; periphery roundly angulate, base almost flat. First 1.5 spire whorls rather evenly convex; on subsequent whorls gently sloping flat or weakly concave subsutural ramp with tightly rounded rim, flat or weakly concave sides, and rounded peripheral bulge. Sculpture of low spiral cords and fine collabral growth lines. Spiral cords weak on spire, only adapical margins sharply defined, about 7 of similar size spread across first 1.3 spire whorls, narrower and more crisply defined abapically; on subsequent whorls absent from ramp, adapical third of side and peripheral bulge; 8 or 9 stronger cords on base. Wall of umbilicus concave, smooth or with few obscure spiral lines. Columella thick, smooth, strongly retracted from rounded adapical boss to insertion. Outer lip simple, rim thin, thicker within, strongly so abapically.

Type data: Holotype NMNZ M.134500 and 28 paratypes (1 AMS, 27 NMNZ), off N face of Hinemoa Island, Three Kings Islands, alive, 23 m, 11 February 1986, scuba, G.S. Hardy. Paratypes: 34°10'S, 172°08'E, off Princes Rocks, Three Kings Islands, dead, 14 m, 4 January 1976, scuba, A. Watson (2, M.49800); 34°10'S, 172°08'E, off Southwest Island, Three Kings Islands, dead, 33 m, 3 January 1976, scuba, A. Watson (5, M.54015); off Hinemoa Island, dead, 18 m, 17 January 1985, scuba F. Brook (3, M.117430); reef between Great Island and Farmer Rocks, Three Kings Islands, dead, 33 m, 17 February 1986, scuba, G.S. Hardy (20, M.93950); 34°11'S, 172°03'E, off West Island, Three Kings Islands, Elingamite wreck, dead, 37 m, 16 March 1981, coll. K. Tarlton (27, M.127361); 34°21'S, 172°37'E, N of Cape Reinga, dead, 88 m, 19 February 1974, r.v. Acheron (1, M.59507)



Figures 40-50.
Shells of *Thoristella* species. **40,41,43,48.** *Thoristella carmesina* (Webster). **40,43.** Maori Rocks, off Fanal Island, Mokohinau Islands, 15 m, M.87323 (5.00 x 6.35 mm). **41.** Off Henry Island, Whangaruru, 12m, M.25935 (6.50 x 7.90 mm). **48.** Protoconch, off Ruamahua-nui Island, Aldermen Islands, 38 m, M.112759. **42,44,46,49.** *T. davegibbsi* n. sp. **42.** Southeast Bay, Great Island, Three Kings Islands, 12 m, paratype, M.117433 (width 6.50 mm). 44,46 (detail). Holotype, Southeast Bay, Great Island, Three Kings Islands, 18-22 m, M.100394 (4.15 x 5.90 mm). **49.** Protoconch of paratype, N of Cape Reinga, 88 m, M.59507. **45,47,50.** *T. polychroma* n. sp. **45,50.** (protoconch). Off Hinemoa Island, Three Kings Islands, 23 m, holotype, M.134500 (3.95 x 4.30 mm). **47.** Off Hinemoa Island, Three Kings Islands, 23 m, paratype, M.112536 (2.60 x 3.65 mm). Scale bar 46 = 500 μm, others = 330 μm.

Remarks: Thoristella polychroma most closely resembles *T. oppressa* in shape, but differs markedly in colour and colour pattern, and in that the protoconch is much larger (width 430 μm, cf. 330 μm), with a broadly rounded instead of pinched tip. The enlarged tip on the protoconch suggegsts that *T. polychroma* has a different type of larval development from other *Thoristella* species: perhaps it is a larval brooder. *T. polychroma* and *T. oppressa* are sympatric north of Cape Reinga.

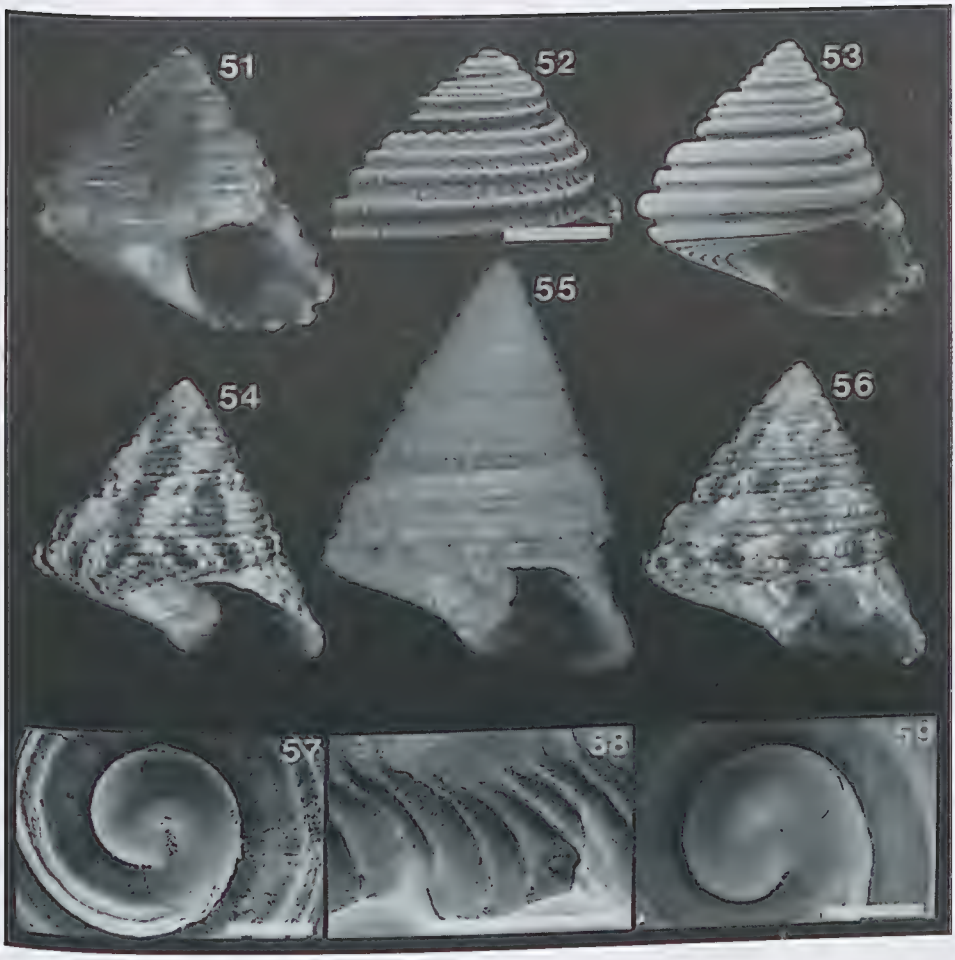
Etymology: Many-coloured (Greek).

Thoristella carinata n. sp.
(Figs 38, 51, 53, 57)

Description: Shell up to 5.75 mm wide, slightly wider than high, strong, spire evenly and broadly conical, narrowly umbilicate. Colour: protoconch white; spire on first 2 teleoconch whorls opaque creamy or pinkish white, spiral cords pink with small white spots; subsequent whorls typically pink, variably and irregularly spotted and axially banded in paler shades or white, last whorl in some specimens with irregular olive-green and/or brown axial maculations on creamy white ground. Base pink, spiral cords spotted darker shades, area between summits of outer basal spiral and abapical fourth spire spiral typically creamy white, umbilicus porcellanous white. Protoconch 330 μm wide, smooth, tip tightly pinched. Teleoconch of up to 4.75 flattened whorls, suture appearing deeply channelled because of strength of spiral sculpture, periphery tightly rounded, base weakly convex; sculptured with prominent smooth, spiral cords. Spiral cords numbering 4 on all spire whorls, and 5, 6 or occasionally 7 on base, abapical third spiral peripheral, summit of fourth (abapical) spiral partly covered by succeeding whorls. Spire spirals all similar and rounded in section on first 2 whorls; thereafter first(adapical) and third spirals enlarging more rapidly than others with adapical spiral strongest, all subquadrate in section with broadly rounded summits and concave sides, interspaces about as broad as second spiral. Basal spirals similar throughout, rounded, transforming to resemble adult spire spirals in section on last adult whorl. Umbilicus narrow, inner part infilled by columella, rim tightly rounded, concave outside columella. Columella strong, rounded, weakly protracted from insertion to low adapical swelling, almost straight abapically. Outer lip simple, rim thin, thickened within. Animal unknown (only 1 live taken juvenile available).

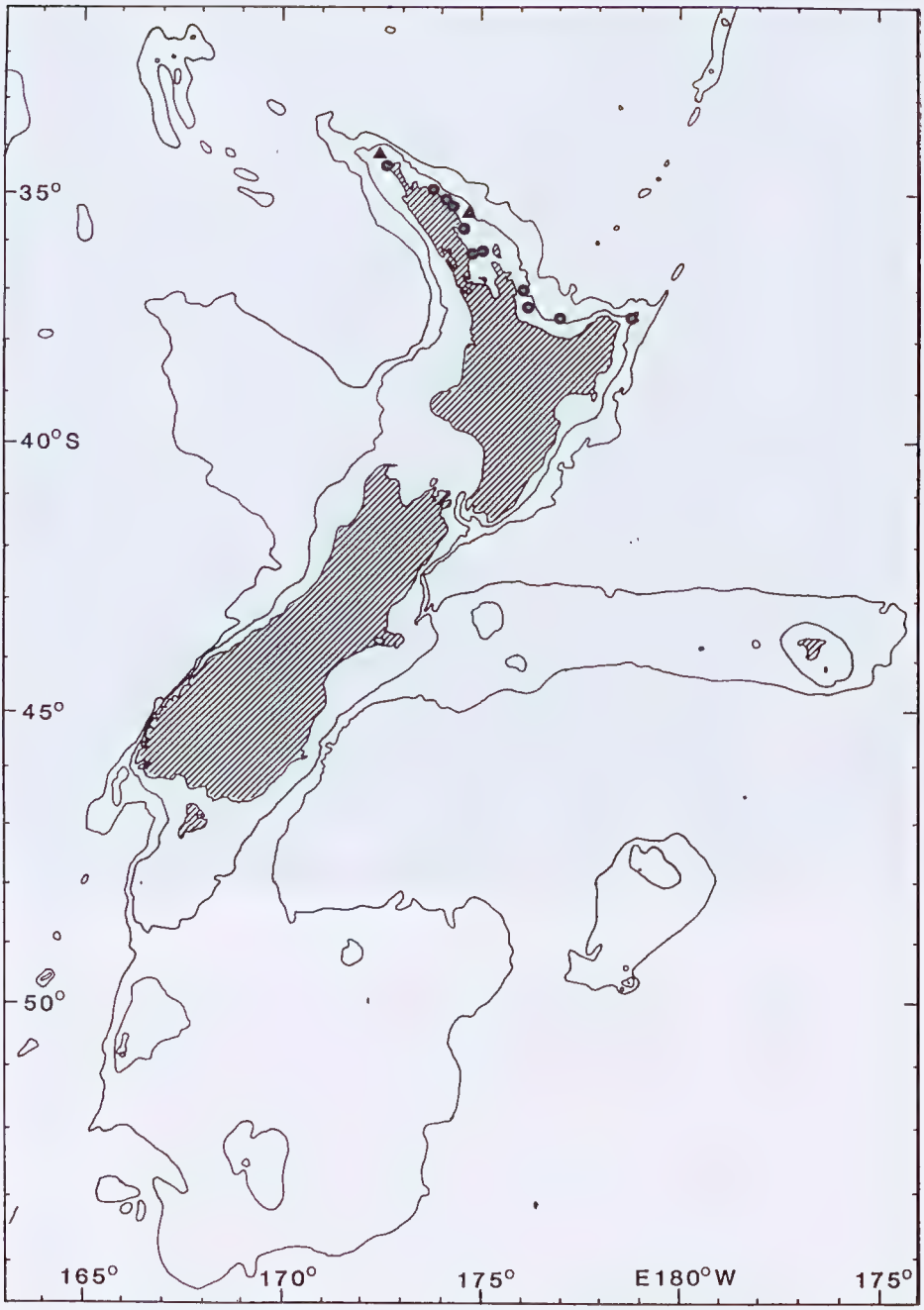
Type data: Holotype NMNZ M.127349 (5.45 x 5.75 mm, 4.75 teleoconch whorls) and 54 paratypes M.127350: 34°11'S, 172°03'E, off West Island, Three Kings Islands, in gravel from Elingamite wreck, 37 m, 16 March 1981, airlifted K. Tarlton. Paratypes: Reef between Great Island and Farmer Rocks, Three Kings Islands, 33 m, 17 February 1986, scuba, G.S. Hardy (90, M.93948).

Other material examined: (several hundred specimens NMNZ). 33°57.0'S, 171°45.4'E, Middlesex Bank, NW of Three Kings Islands, dead, 98-103 m, 31 January 1981, r.v. Tangaroa (5, M.127382); 33°57.0'S, 172°19.0'E, King Bank, N of Three Kings Islands, dead, 128 m, 1 February 1981, r.v. Tangaroa (3, M.127379);

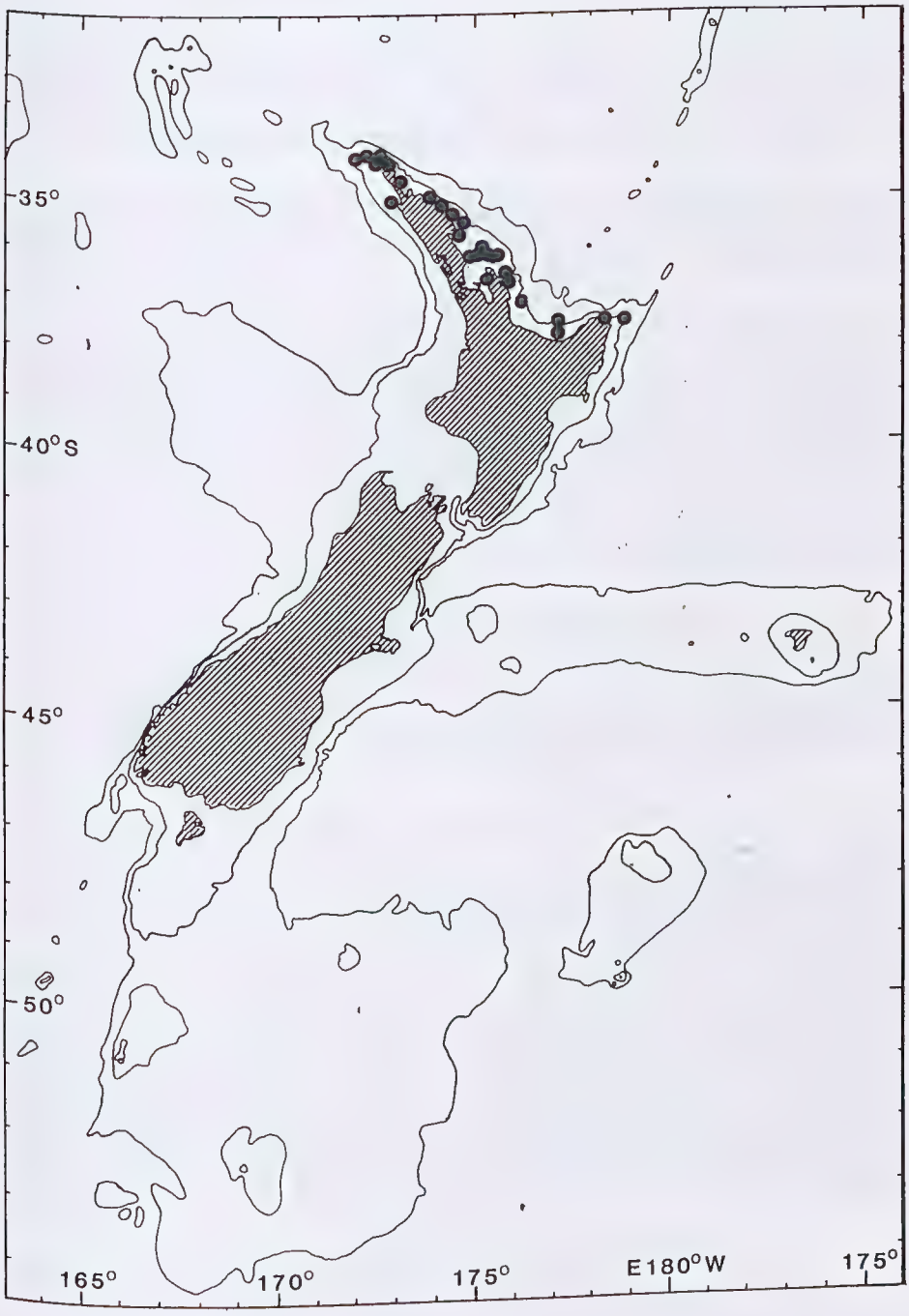


Figures 51-59.
Shells of *Thoristella* and *Clanculus* species. **51,53,57.** *T. carinata* n. sp. **51.** Reef between Great King Island and Farmer Rocks, Three Kings Islands, 33 m, paratype, M.93948 (4.00 x 4.45 mm). **53.** Off West Island, Three Kings Islands, 37 m, holotype, M.127349 (5.40 x 5.80 mm). **57.** Protoconch, off Hinemoa Island, Three Kings Islands, 23 m, M.112537. **52,54-56, 58,59.** *C. peccatus* (Finlay). 52,58 (detail), 59 (protoconch). Juvenile, Southeast Bay, Great Island, Three Kings Islands, 55 m, M.33824. **54.** Moturua Island, Bay of Islands, 9m, M.117851 (11.0 x 11.0 mm). **55.** Poor Knights Islands, 11-13 m, M.100392 (15.0 x 11.0 mm). **56.** Cape Rodney, 16m, M.117852 (12.0 x 11.4 mm). Scale bar 52 = 1 mm, others = 170 μm.

33°57.4'S, 172°19.4'E, King Bank, dead, 128-123 m, 1 February 1981, r.v. Tangaroa (many fragments, M.72054); 34°10'S, 172°08'E, off Southwest Island, Three Kings Islands, dead, 33 m, 3 January 1976, scuba, A. Watson (4, M.54019); 34°10'S, 172°08'E, off Princes Rocks, Three Kings Islands, dead, 14 m, 4 January 1976, scuba, A. Watson (3, M.49905); off N face of Hinemoa Island, Three Kings Islands, alive, 23 m, 11 February 1986, scuba, G.S. Hardy (46, M.112537); 34°10'S, 172°08'E, outer Southeast Bay, Great Island, Three Kings Islands, dead, 55 m, 18



Figures 60
Map of New Zealand region showing distributions of *Thoristella* and *Clanculus* species. 200 and 1000 metre contours indicated. **60.** *T. carmesina* (Webster) (●) and *T. davegibbsi* n. sp. (▲).



Figures 61
Map of New Zealand region showing distributions of *Thoristella* and *Clanculus* species. 200 and 1000 metre contours indicated. **61.** *C. peccatus* (Finlay).

February 1974, r.v. Acheron (3, M.127378); off Princes Rocks, dead, 15 m, 2 December 1983, scuba G.S. Hardy and A.L. Stewart (2, M.127380); Arch Pinnacle, Three Kings Islands, dead, 40 m, 10 March 1983, scuba F. Brook (1, M.109335); 34°21'S, 172°37'E, N of Cape Reinga, dead, 88 m, 19 February 1974, r.v. Acheron (1, M.35910); 37°33.8'S, 176°59.0'E, Rungapapa Knoll, WNW of White Island, Bay of Plenty, dead, 188-228 m, 20 January 1979, r.v. Tangaroa (4, M.127381).

Distribution: (Fig. 38). Off Three Kings Islands and Rungapapa Knoll, Bay of Plenty, northern New Zealand, 14-228 m, taken alive (juvenile) at 23 m, common on rocky ground.

Remarks: Although this species is clearly referable to Trochini on the basis of insertion of the columella into the umbilicus, the teleoconch sculpture is very distinctive and relationships within the group are obscure. The lack of a spiral cord on the umbilical wall, infilling of the umbilicus by the columella, and small size, however, suggest that it may belong in *Thoristella*. Fragmentary specimens are up to 7.90 mm wide.

Etymology: Keeled (Latin).

Genus **Clanculus** Montfort, 1810

Clanculus Montfort, 1810: 191.
Type species (by original designation): *Trochus pharaonius* Linnaeus, 1758; Recent, Red Sea, Arabian Sea and Arabian Gulf.

Subgenus **Paraclanculus** Finlay, 1926

Paraclanculus Finlay, 1926: 351.
Type species (by original designation): *Paraclanculus peccatus* Finlay, 1926; Recent, New Zealand.

Remarks: Clanculus has been divided into a number of subgenera that are difficult to objectively define (Herbert, 1993), and most of which are of doubtful value. Nevertheless, it seems appropriate to retain *Paraclanculus* as a subgenus because its type species differs from the type species of *Clanculus* (s. str.) and *Clanculopsis* Monterosato, 1879 (type species *Trochus cruciatus* Linnaeus, 1758) in being conical instead of turbiniform, with flattened instead of convex spire whorls.

Clanculus (Paraclanculus) peccatus (Finlay, 1926)
(Figs 54-56, 58, 59, 61)

Trochus (Clanculus) ringens.- Suter, 1897: 262; Suter, 1913: 112, pl. 38, fig. 3 (not Menke, 1843).
Paraclanculus peccatus Finlay, 1926: 351, pl. 18, fig. 17; Cernohorsky, 1972: 238, fig. 9.

Clanculus (Paraclanculus) peccatus.- Powell, 1976: 83; Powell, 1979: 60, pl. 17, fig. 4.

Type data: Holotype AIM TM584, Tryphena, Great Barrier Island.

Other material examined: Several hundred specimens in 78 lots NMNZ.

Distribution: (Fig. 61). Three Kings Islands, east and west coasts of Northland, and north-eastern North Island to as far south as Ranfurly Bank, East Cape, northern New Zealand, 0-622 m, taken alive at 4-56 m from rocky substrata. Specimens taken alive by divers were living under rocks.

Remarks: Clanculus peccatus is particularly variable in colour, colour pattern and shell shape, which ranges from wider than high to higher than wide. There are typically four primary spiral cords on the spire whorls (excluding abapical spiral, summit of which is mostly covered by succeeding whorls), though specimens with five cords are not uncommon. The nodules on the spire range from hemispherical to axially elongate, and the space between the two peripheral spirals and the adapical spire spirals may be narrower or broader than each spiral. The large tooth at the base of the columella is typically biplicate, but the secondary (abapical) plication may be absent.

As suggested by Powell (1958, 1979), and confirmed by comparison of actual specimens, *Trochus (Clanculus) takapunaensis* Webster, 1906 (AIM AK70778), reputedly from Takapuna, Auckland, is based on a mislocalised example of the southern Australian species *Clanculus plebejus* (Philippi, 1851).

Acknowledgements

I am grateful to P. Bouchet and V. Heros (Muséum National d'Histoire Naturelle, Paris), B. Hayward (Auckland Institute and Museum) and K.M. Way (The Natural History Museum, London) for the loan of type and other material; A.G. Beu (Institute of Geological and Nuclear Sciences, Lower Hutt) for access to fossil material; and K. Burch (Whangarei), D. Gibbs (late of Auckland), S. O'Shea (National Institute of Water and Atmospheric Research, Wellington) and R.C. Willan (Darwin) for the gift and/or loan of Recent material. Thanks also to D.G. Herbert (Natal Museum, Pietermaritzburg) for comments on the manuscript, W. St. George (Institute of Geological and Nuclear Sciences, Lower Hutt) and R. Thompson (Victoria University of Wellington) for access to scanning electron microscopes, and to N. Heke and M. Hall (Museum of New Zealand) for photography and photographic printing respectively.

References

Adams, A. 1853. Contributions towards a monograph of the Trochidae, a family of gasteropodous Mollusca. *Proceedings of the Zoological Society of London* **19 (1851):** 150-192.

Adams, A. 1855. Descriptions of thirty-nine new species of shells, from the collection of Hugh Cuming, Esq. *Proceedings of the Zoological Society of London* **22 (1854):** 130-138.

Beu, A.G. & Maxwell, P.A. 1990. Cenozoic Mollusca of New Zealand. *New Zealand Geological Paleontological Bulletin* **58.** 518pp.
Boreham, A. 1959. Biological type specimens in the New Zealand Geological Survey. 1. Recent Mollusca. *New Zealand Geological Survey Paleontological Bulletin* **30.** 75pp.
Cernohorsky, W.O. 1972. Type specimens of Recent and fossil Mollusca described by H.J. Finlay. *Records of the Auckland Museum* **9:** 231-247.
Cernohorsky, W.O. 1974. Type specimens of Mollusca in the University Zoological Museum, Copenhagen. *Records of the Auckland Museum* **11:** 143-192.
Chemnitz, J.H. 1781. Neues systematisches Conchylien Cabinet 5. Raspe, Nuremberg. 324pp.
Cossmann, M. 1918. Essais de paléoconchologie comparée 11. Cossmann, Paris. 388pp.
Dillwyn, L.W. 1817. A descriptive catalogue of Recent shells, arranged according to the Linnaean method; with particular attention to the synonymy. 2. *Arch, London*: 581-1092.
Finlay, H.J. 1924. Some necessary changes in names of New Zealand Mollusca. *Proceedings of the Malacological Society of London* **16:** 99-107.
Finlay, H.J. 1926. A further commentary on New Zealand molluscan systematics. *Transactions of the New Zealand Institute* **57:** 320-485.
Finlay, H.J. 1928. The Recent Mollusca of the Chatham Islands. *Transactions of the New Zealand Institute* **59:** 232-286.
Fischer, P. 1875-1880. Spécies général et iconographie des coquilles vivantes, comprenant la collection du Muséum d'Histoire Naturelle de Paris, la collection Lamarck, celle du Prince Massene, et les découvertes récentes des voyageurs. 11. Baillière, Paris. 480pp.
Fischer, P. 1880-1887. Manuel de conchyliologie et de paléontologie conchyliologique ou histoire naturelle des mollusques vivants et fossiles... Savy, Paris. 1369pp.
Gmelin, J.F. 1791. Caroli a Linné... Systema naturae per regna tria naturae, secundum classes... Editio decima tertia, aucta, reformata 1 (6). Vermes testacea. Beer, Lipsiae: 3021-4120.
Gould, A.A. 1849. [Shells collected by the United States Exploring Expedition under the command of Charles Wilkes.] *Proceedings of the Boston Society of Natural History* **3:** 89-92.
Gould, A.A. 1852. Mollusca and shells. United States Exploring Expedition during the years 1839-1842 under the command of Charles Wilkes, U.S.N. 12. Gould and Lincoln, Boston. 510pp.
Gray, J.E. 1835. Catalogue of shells collected on the east coast of New Zealand, by the Rev. W. Yate. Appendix, pp 307-310 in Yate, W., An account of New Zealand; and of the formation and progress of the Church Missionary Society's mission in the northern island. Seeley and Burnside, London.
Gray, J.E. 1843. Catalogue of the species of Mollusca and their shells, which have hitherto been recorded as found at New Zealand, with the description of some lately discovered species. Appendix 4, pp 228-265 in Dieffenbach, E., Travels in New Zealand; with contributions to the geography, geology, botany, and natural history of that country. 2. Murray, London.
Gray, J.E. 1856. On the abnormal operculum of Polydonta elegans of New Zealand. *Annals and Magazine of Natural History, including Zoology, Botany, and Geology* **2 (18):** 468-469.
Gray, J.E. 1857. Guide to the systematic distribution of Mollusca in the British Museum. Part 1. Taylor and Francis, London. 230pp.
Hamilton, A. 1906. The Marine Mollusca of New Zealand. *Colonial Museum Bulletin* **1:** 23-51
Herbert, D.G. 1993. Revision of the Trochinae, tribe Trochini (Gastropoda: Trochidae) of southern Africa. *Annals of the Natal Museum* **34:** 239-308.

Hickman, C.S. and McLean, J.H. 1990. Systematic revision and suprageneric classification of trochacean gastropods. *Natural History Museum of Los Angeles, Science Series* **35.** 169pp.

Hickman, C.S. 1992. Reproduction and development of trochacean gastropods. *The Veliger* **35:** 245-272.

Hombron, J.B. & Jacquinot, C.H. 1854. Description des mollusques coquilles et zoophytes. In Rousseau, L. (ed.) Voyage au Pole Sud et dans l'Océanie sur les corvettes l'Astrolabe et la Zélée; execute par ordre du Roi pendant les anées 1837-1838-1839-1840, sous le commandement de M.J. Dumont-Durville, capitaine de vaisseu, commandant de la Zélée. Zoologie 5. Gide and Baudry, Paris. 132pp.

Hutton, F.W. 1873. Catalogue of the marine Mollusca of New Zealand, with diagnoses of the species. Didsbury, Government Printer, Wellington. 116pp.

Hutton, F.W. 1878. Révision des coquilles de la Nouvelle-Zélande et des Îles Chatham. *Journal de Conchyliologie* **26:** 5-57.

Hutton, F.W. 1880. Manual of the New Zealand Mollusca. A systematic and descriptive catalogue of the marine and land shells, and of the soft mollusks and Polyzoa of New Zealand and the adjacent islands. Hughes, Government Printer, Wellington. 224pp.

Hutton, F.W. 1883a. Notes on some branchiate gastropods. *Transactions and Proceedings of the New Zealand Institute* **15:** 118-131.

Hutton, F.W. 1883b. Descriptions of some new Tertiary shells from Wanganui. *Transactions and Proceedings of the New Zealand Institute* **15:** 410-411.

Hutton F.W. 1884. Revision of the Recent rhipidoglossate and docoglossate Mollusca of New Zealand. *Proceedings of the Linnean Society of New South Wales* **9:** 354-378.

Hutton, F.W. 1893. The Pliocene Mollusca of New Zealand. Pp 35-92 in Fletcher, J.J. (ed.), The MacLeay Memorial Volume. Sydney. Linnean Society of New South Wales.

Iredale, T. 1912. New generic names and new species of marine Mollusca. *Proceedings of the Malacological Society of London* **10:** 217-228.

Iredale, T. 1915. A commentary on Suter's "Manual of the New Zealand Mollusca". *Transactions of the New Zealand Institute* **47:** 417-497

Keen, A.M. 1960. In Moore, R.C. (ed.), Treatise on invertebrate paleontology. Part I, Mollusca 1. Geological Society of America and University of Kansas Press. 351pp.

Kiener, L.C. 1850. Spécies général et iconographie des coquilles vivantes, comprenant la collection du Muséum d'Histoire naturelle de Paris, la collection Lamarck, celle du Prince Massene, et les découvertes récentes des voyageurs. Genre *Trochus* (plates only). Baillière, Paris.

Linnaeus, C. 1758. Systema naturae per regna tria naturae... Editio decima (1). Salvii, Holmii. 1-823

Marshall, B.A. 1979. The Trochidae and Turbinidae of the Kermadec Ridge (Mollusca: Gastropoda). *New Zealand Journal of Zoology* **6:** 521-552.

Marshall, B.A. 1983. Acremodontinae: a new subfamily of the Trochidae (Mollusca: Gastropoda). *National Museum of New Zealand Records* **2:** 127-130.

Marshall, B.A. 1995. Recent and Tertiary Trochaclididae from the Southwest Pacific (Mollusca: Gastropoda: Trochoidea). *The Veliger* **38:** 92-115.

Marshall, B.A. 1996. Molluscan name-bearing types in the Museum of New Zealand Te Papa Tongarewa. *Tuhinga: Records of the Museum of New Zealand Te Papa Tongarewa* **9:** 1-85.

Montfort, P.D. de, 1810. Conchyliologie systématique et classification méthodique de coquilles... 2. Schoell, Paris. 676pp.

Odhner, N. 1924. New Zealand Mollusca. Papers from Dr Th. Mortensen's Pacific Expedition 1914-16. 19. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening; Kjobenhavn* **77:** 1-90.

Philippi, R.A. 1846. Diagnoses testaceorum quorundam novorum. *Zeitschrift für Malakozoologie* **3:** 97-106.

Philippi, R.A. 1846-1855. [*Trochus, Xenophorus*] In Küster, H.C. and Kobelt, W. (eds.) Systematisches Conchylien-Cabinet von Martini und Chemnitz... 2 (3). Bauer and Raspe, Leipzig. 372pp.

Pilsbry, H.A. 1889-1890. Manual of conchology; structural and systematic, with illustrations of the species. 11. Academy of Natural Sciences, Philadelphia. 519pp.

Powell, A.W.B. 1933. Marine Mollusca from the Bounty Islands. *Records of the Canterbury Museum* **4:** 29-39.

Powell, A.W.B. 1946a. The shellfish of New Zealand. An illustrated handbook (2ndp edition). Whitcombe and Tombs, Christchurch. 106p.

Powell, A.W.B. 1946b. New species of New Zealand Mollusca from the South Island, Stewart Island, and Chatham Islands. *Records of the Auckland Institute and Museum* **3:** 137-144.

Powell, A.W.B. 1955. Mollusca of the southern islands of New Zealand. *Cape Expedition - Scientific Results of the New Zealand Sub-Antarctic Expedition, 1941-45. Bulletin* 15. 151pp.

Powell, A.W.B. 1957. Shells of New Zealand. An illustrated handbook (3rd edition). Whitcombe and Tombs, Christchurch. 202pp.

Powell, A.W.B. 1958. New Zealand molluscan systematics with descriptions of new species, Part 3. *Records of the Auckland Institute and Museum* **5:** 87-91.

Powell, A.W.B. 1962. Shells of New Zealand. An illustrated handbook (4th edition). Whitcombe and Tombs, Christchurch. 203pp.

Powell, A.W.B. 1974. New Zealand molluscan systematics with descriptions of new species. Part 8. *Records of the Auckland Institute and Museum* **11:** 197-207.

Powell, A.W.B. 1976. Shells of New Zealand. An illustrated handbook (5th edition). Whitcoulls, Christchurch. 154pp.

Powell, A.W.B. 1979. New Zealand Mollusca. Marine, land and freshwater shells. Collins, Auckland. 500pp.

Quoy, J.C.R. 7 Gaimard, P. 1834. Voyage de découverts de l'Astrolabe, exécuté par ordre du Roi pendant les années 1826-1827-1828-1829, sous le commandement de M.J. Dumont d'Urville. Zoologie. Mollusques 3. Tastu, Paris. 1-366.

Reeve, L. 1861-62. Conchologia iconica: or illustrations of the shells of molluscous animals 13. Monograph of the genus *Trochus*. Reeve, London. 16 plates.

Smith, E.A. 1874. Mollusca. In Richardson, J. and Gray, J.E. (eds.), The zoology of the voyage of H.M.S. Erebus and Terror, under the command of Captain Sir James Clark Ross, R.N., F.R.S., during the years 1839 to 1843. Jason, London. 7pp.

Smith, E.A. 1902. Mollusca. Report on the collections of natural history made in the Antarctic regions during the voyage of the "Southern Cross": 201-213

Smith, E.A. 1915. Mollusca. Part 1.- Gastropoda Prosobranchia, Scaphopoda, and Pelecypoda. British Antarctic ("Terra Nova") Expedition, 1910. *Natural History Report. Zoology* **2 (4):** 61-112.

Sowerby, G.B. 1870. Descriptions of forty-eight new species of shells. *Proceedings of the Zoological Society of London* **1870:** 249-259.

Suter, H. 1897. Revision of the New Zealand Trochidae. *Proceedings of the Malacological Society of London* **2:** 260-290.

Suter, H. 1908. Additions to the marine molluscan fauna of New Zealand, with descriptions of new species. *Proceedings of the Malacological Society of London* **8:** 22-42.

Suter, H. 1913. Manual of the New Zealand Mollusca. With an atlas of quarto plates [1915]. Mackay, Government Printer, Wellington. 1120pp.

Thiele, J. 1929. Handbuch der Systematischen Weichtierkunde 1 (1). Fischer, Jena. 1-376.
Webster, W.H. 1906. Additions to the New Zealand fauna. *Transactions and Proceedings of the New Zealand Institute* **38 (1905):** 309-312.
Webster, W.H. 1908. Additions to the New Zealand fauna. *Transactions and Proceedings of the New Zealand Institute* **40 (1907):** 254-259.
Wenz, W. 1938. Gastropoda. Teil 1: Allgemeiner Teil und Prosobranchia 2 (3): 241-480. In Schindewolf, O.H. (ed.) *Handbuch der Paläozoologie* **6.** Borntraeger, Berlin.

Key to New Zealand Recent *Trochus, Clanculus* and *Thoristella* species (adult shells).

1. Shell more than 10 mm wide - 2
   Shell less than 10 mm wide - 5

2. Spiral cords on spire without nodules and traversed by axial riblets (Three Kings Islands and northern North Island) - *Trochus (Camelotrochus) camelophorus* (Figs 14, 16).
   Spiral cords on spire with rounded nodules - 3

3. Inner lip with strong tooth at base (Three Kings Islands and northern North Island) - *Clanculus (Paraclanculus) peccatus* (Figs 54-56).
   Inner lip without tooth at base - 4

4. Umbilical wall with 2 spiral cords, spiral cords on spire strongly nodular, periphery nodular, greenish (widely distributed) - *Trochus (Thorista) viridis* (Figs 5-8, 10).
   Umbilical wall smooth, spiral cords on spire finely nodular, periphery not nodular, whitish with brown spots (widely distributed) - *Trochus (Coelotrochus) tiaratus* (Figs 1-4).

5. No distinct axial riblets in spiral interspaces - 6
   Distinct, fine, crisp axial riblets in spiral interspaces on spire - 7

6. Spire whorls with 3 strong spiral cords with deep interspaces, not stepped, suture deeply chanelled (Three Kings Islands and rarely subtidally off northeastern North Island) - *Thoristella carinata* (Figs 51, 53).
   Spire whorls with weak spiral sculpture, strongly stepped, suture not channelled (Three Kings Islands and off Cape Reinga) - *Thoristella polychroma* (Figs 45, 47).

7. Spire whorls strongly stepped or medially angulate - 8
   Spire whorls not stepped or medially angulate - 9

8. Spire whorls strongly stepped, whorls flattened, no nodules, typically greenish, reddish axial bands on first teleoconch whorl (Three Kings Islands and North Island as far south as Mahia Peninsula) - *Thoristella oppressa* (Fig. 33).

Spire whorls with low median angulation and subsutural and median row of nodules, typically pinkish, pinkish axial bands on early teleoconch whorls (Three Kings Islands only) - *Thoristella rex* (Fig. 31).

9. Spire whorls flattened, reddish spiral bands on early teleoconch whorls (Cook Strait, South Island, Stewart Island, The Snares, subantarctic islands, and Chatham Islands) - *Thoristella chathamensis* (Figs 17-30).

Spire whorls rounded, reddish spiral or axial bands on early teleoconch whorls - 10

10. Red spiral bands on early spire whorls, typically greenish (Three Kings Islands, off Cape Reinga, and off Poor Knights Islands) - *Thoristella davegibbsi* (Figs 42, 44).

Red axial bands on early spire whorls (north-eastern North Island as far south as East Cape), typically reddish - *Thoristella carmesina* (Figs 40, 41, 43).

Molluscan Research 19(1): 107-156 *(1998)*

The New Zealand Recent species of *Cantharidus* Montfort, 1810 and *Micrelenchus* Finlay, 1926 (Mollusca: Gastropoda: Trochidae)

Bruce A. Marshall

Museum of New Zealand Te Papa Tongarewa
P.O. Box 467, Wellington, New Zealand

Abstract

The New Zealand Recent species of *Cantharidus* Montfort, 1810 (3 species) and *Micrelenchus* Finlay, 1926 (10 species) are revised, illustrated and keyed. A new species of *Cantharidus* and a new *Micrelenchus* species are described from north of Cape Reinga. *Micrelenchus huttonii* (Smith, 1876) is resurrected from synonymy under *M. tenebrosus* (A. Adams, 1853). The following seven taxa are newly synonymised: *Cantharidus opalus cannoni* Powell, 1933 with *C. opalus* (Martyn, 1784); *Cantharidus coruscans* Hedley, 1916 with *M. capillaceus* (Philippi, 1848); *Cantharidus sanguineus elongatus* Suter, 1897, *Gibbula micans* Suter, 1897 and *M. sanguineus bakeri* Fleming, 1948 with *Canthiridus artizona* A. Adams, 1853; *M. oliveri cryptus* Powell, 1946 with *M. sanguineus* (Gray, 1843); *M. parcipictus* Powell, 1946 with *M. tenebrosus* (A. Adams, 1853); *M. caelatus morioria* Powell, 1933 and *M. caelatus archibenthicola* Dell, 1956 with *M. mortenseni* (Odhner, 1924). A new subgenus of *Cantharidus* is introduced for *C. purpureus* (Gmelin, 1791). *Plumbelenchus* Finlay, 1926 is interpreted as a subgenus of *Micrelenchus*, and 7 species are newly transferred there. Lectotypes are designated for *Canthiridus tenebrosus* A. Adams, 1853, *Trochus (Canthiridus) huttonii* Smith, 1876, *Canthiridus zealandicus* A. Adams, 1853, *Cantharidus pruninus minor* Smith, 1902, *Photinula coruscans* Hedley, 1916, *Canthiridus artizona* A. Adams, 1853, *Canthiridus rufozona* A. Adams, 1853, *Cantharidus sanguineus caelatus* Hutton, 1884, and *Gibbula mortenseni* Odhner, 1924. Neotypes are designated for *Limax opalus* Martyn, 1784, *Trochus iris* Gmelin, 1791 and *Trochus acuminatus* Perry, 1811 (= *Cantharidus opalus*); *Helix purpurea* Gmelin, 1791, *Trochus rostratus* Gmelin, 1791 and *Trochus elegans* Gmelin, 1791 (= *Cantharidus purpureus*); and *Gibbula plumbea* Hutton, 1878 (= *Micrelenchus huttonii*).

Key words: Recent, New Zealand, Mollusca, Gastropoda, Trochidae, Cantharidini, *Cantharidus*, *Micrelenchus*, *Plumbelenchus*, lectotypes, neotypes, new taxa.

Introduction

Cantharidus and *Micrelenchus* species are small to medium-sized trochid gastropods that are a significant component of the New Zealand marine biota. Several species live on algae and under stones in the intertidal zone and shallow sublittoral, one lives in estuaries, whilst others are exclusively sublittoral. Judging from gut contents, all are detritivores. Though all are common, some of the *Micrelenchus* species have been notoriously difficult to identify because of their small size and uncertainty regarding limits of variation in shell morphology, colour and colour pattern. As a consequence, distinct species have been interpreted either as synonyms or obscured in a confusion of regional or "bathymetric" subspecies. The present contribution is an attempt to rectify these problems, being based on study of the most extensive collections available, and all extant type material. All species are discussed and illustrated, and an identification key is provided.

Abbreviations and text conventions:

AIM - Auckland Institute and Museum;
BMNH - The Natural History Museum, London;
CM - Canterbury Museum, Christchurch;
H/D - height/diameter ratio;
MNHN - Muséum National d'Histoire Naturelle, Paris;
NMNZ - Museum of New Zealand Te Papa Tongarewa, Wellington;
NZGS - Institute of Geological and Nuclear Sciences, Lower Hutt;
NZOI - National Institute of Water and Atmospheric Research, Wellington;
SD - standard deviation.

Height dimension precedes diameter in measurements of shells. All material is at NMNZ unless specified (registration numbers preceded by "M.").

Systematics

Superfamily **TROCHOIDEA** Rafinesque, 1815
Family **TROCHIDAE** Rafinesque, 1815
Subfamily **TROCHINAE** Rafinesque, 1815
Tribe **CANTHARIDINI** Cotton, 1959

Cantharidinae Cotton, 1959: 104.
Cantharinae Kuroda, Habe and Oyama, 1971: 86.
Canthariinae Higo and Goto, 1993: 39.

Remarks: The classification adopted here follows that of Hickman and McLean (1990).

Some New Zealand Cantharidini exhibit strong clinal variation in shell morphology, whereas other species are rather similar throughout wide distributions, probably at least in part due to interspecific differences in dispersal potential of eggs or larvae. Nothing is known of the early life history of any New Zealand Cantharidini other than *Cantharidus coruscans* Hedley, 1916 (= *Micrelenchus capillaceus* (Philippi, 1848)), which is a broadcast spawner (Simpson, 1977). The few other Cantharidini for which development is known lay their eggs in a string in a mass of jelly attached to algae, stones or shells (Hickman, 1992). All New Zealand species have a small protoconch with a narrowly pinched tip, suggesting that each embryo has a particularly small yolk volume. All New Zealand Cantharidini have three pairs of epipodial tentacles, a characteristic of the group.

Genus **Cantharidus** Montfort, 1810

Cantharidus Montfort, 1810: 251.
Type species (by original designation): *Trochus iris* Gmelin, 1791 = *Limax opalus* Martyn, 1784; Recent, New Zealand. *Canthiridus* (Gray, 1853) and *Cantharidium* (Schaufuss, 1869) are incorrect subsequent spellings.
Elenchus Swainson, 1840: 351.
Type species (by subsequent designation of Herrmannsen, 1847): "*Trochus iridis*

Chemnitz" = *Limax opalus* Martyn, 1784. *Eleuchus* (Gray, 1853) is a spelling variant.

Diagnosis: Shell 20-53 mm high at maturity, higher than broad, anomphalous, axial sculpture strong or absent, spiral cords smooth or surmounted by finer spiral cords; inner lip with moderate or very weak flexure at base, smooth. Three pairs of relatively small epipodial tentacles. Left neck lobe smooth or digitate. Side of foot weakly or strongly pustulose. Central radular tooth with broad or very broad tip, and broad lateral projections.

Remarks: New Zealand species are here referred to two subgenera, one of which is new.

Subgenus **Cantharidus** Montfort, 1810

Diagnosis: Shell up to 53 mm high at maturity, moderate flexure at base of inner lip. Early teleoconch whorls sculptured with low, smooth spiral cords, later whorls with fine spiral grooves, no axial sculpture. Left neck lobe smooth. Side of foot weakly pustulose. Central radular tooth with broader tip than in *Mawhero* or *Micrelenchus*.

Remarks: Cantharidus (s. str.) is here considered to be monotypic. *Phasianotrochus* Fischer, 1885 (type species *Trochus badius* Wood, 1828 = *Bulimus eximius* Perry, 1811; Recent, southern Australia) appears to be closely related. Whether or not Australian species currently referred to *Cantharidus* (Wilson, 1993) and Japanese species such as *Cantharidus japonicus* (A. Adams, 1853) belong in *Cantharidus* (s. str.) remains to be determined.

Cantharidus (Cantharidus) opalus (Martyn, 1784)
(Figs 1-4, 9, 12, 15, 82, Graph 1)

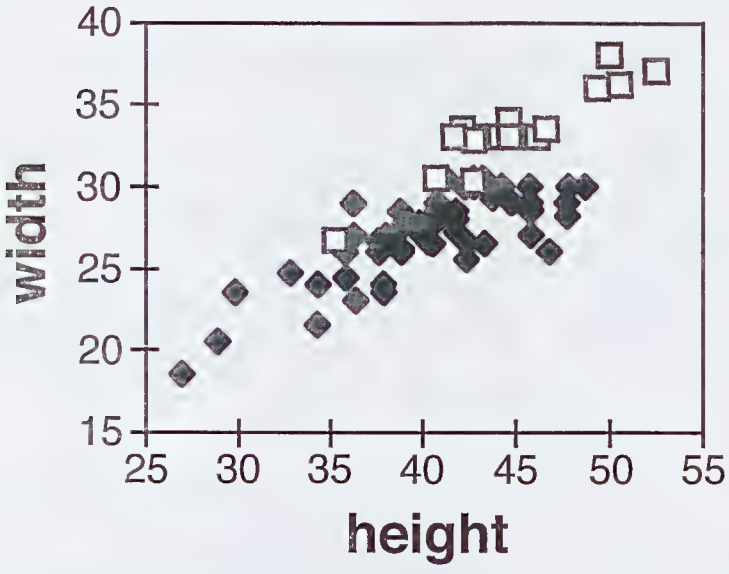
Walch, 1774: 42, pl. 1, fig. 6 (fig. 5 = *C. purpureus?*). Not binomial.
Zorn, 1775: 161, pl. 2, fig. C1, C2. Not binomial.
Chemnitz, 1781: 27, pl. 161, fig. 1522, 1523. Not binomial.
Limax opalus Martyn, 1784: fig. 24. (ICZN op. 479)
Trochus iris Gmelin, 1791: 3580 (Refers to Walch, 1774, pl. 1, fig. 5, 6; Zorn, 1775, pl. 2, fig. C1, C2; Chemnitz, 1781, pl. 161, fig. 1522, 1523; and (variety B) Martyn, 1784, fig. 24); Spalowsky, 1795: 49, pl. 8, fig. 2a, b; Philippi, 1847: 9, pl. 2, fig. 7, 8, pl. 46, fig. 9; Kiener, 1850: pl. 51, fig. 4; Fischer, 1877: 157, pl. 51, fig. 4.
Cantharidus iris.- Montfort, 1810: 251.
Trochus acuminatus Perry, 1811: pl. 47, fig. 1.
Elenchus iris.- Swainson, 1840: 351; Gray, 1843: 239; Fischer, 1885: 819, pl. 10, fig. 8.
Trochus (Elenchus) iris.- Woodward, 1851: 144, pl. 10, fig. 8.
Canthiridus [sic] *iridis* A. Adams, 1853: 169 (unjustified emendation of *iris*).
Cantharidus iris.- Hutton, 1873: 39; Hutton, 1880: 99; Pilsbry, 1889: 122, pl. 34, fig. 15; Suter, 1897: 268.

Cantharidus opalus.- Hedley, 1906: 49; Suter, 1913: 124, pl. 8, fig. 10; Finlay, 1928: 238; Hickman and McLean, 1990, fig. 61a.
Cantharidus opalus biangulatus Suter, 1908: 22.
Cantharidus (Cantharidus) opalus.- Finlay, 1926: 370; Thiele, 1929: 51, fig. 33; Wenz, 1938: 302, fig. 667.
Cantharidus opalus cannoni Powell, 1933: 194, pl. 36, fig. 15, 16; Powell, 1979: 54, pl. 18, fig. 2. New synonym
Cantharidus (Cantharidus) iris.- Keen, 1960: 253, fig. 163/19.
Cantharidus opalus opalus.- Powell, 1979: 54, pl. 11, fig. 1, pl. 18, fig. 1.

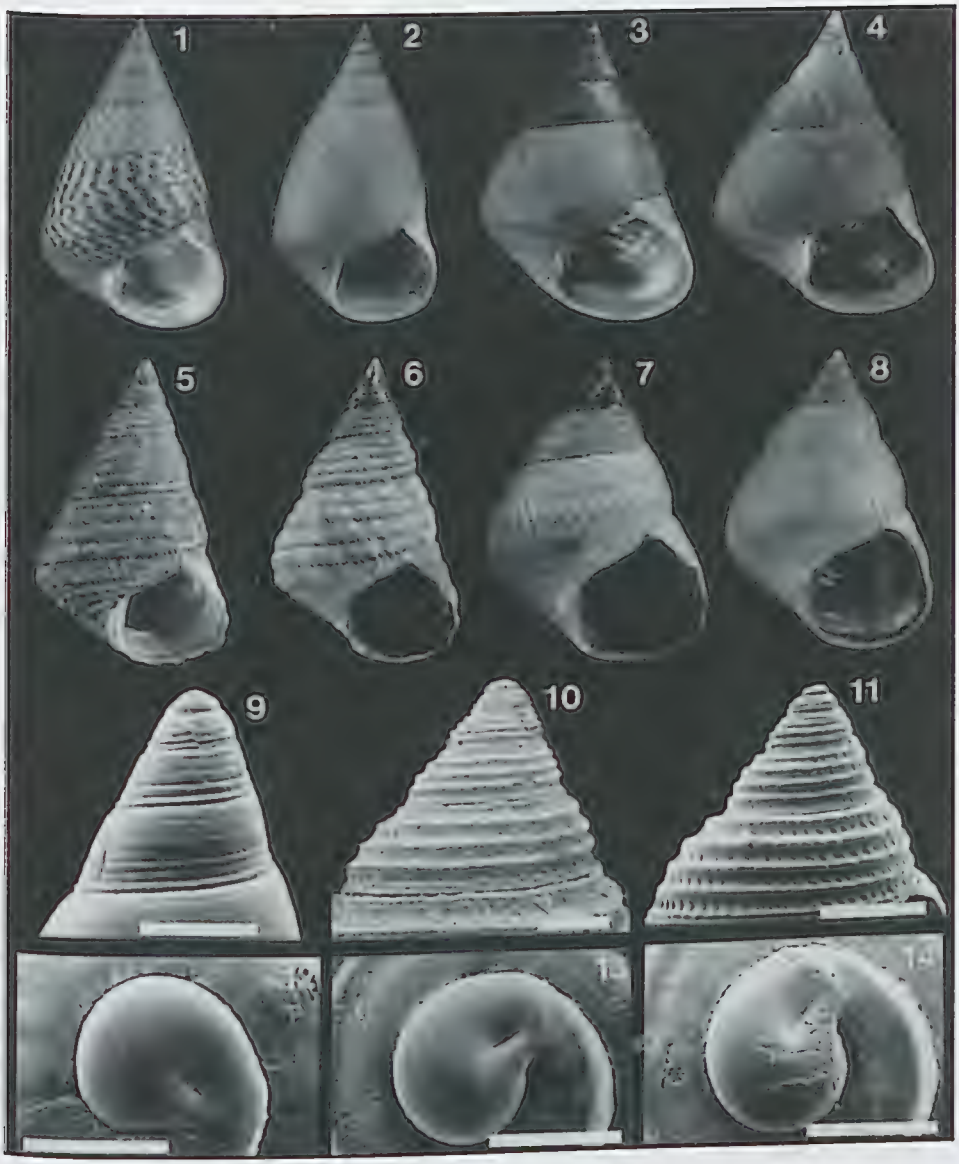
Type data:
Limax opalus ("New Zealand"), *Trochus iris* ("Neu-Seeland") and *Trochus acuminatus* ("New Zealand"): Neotype NMNZ M.138236, off Matakaoa Point, Hicks Bay, on algae, 9-12 m, scuba, A.L. Stewart;
Cantharidus opalus biangulatus: Holotype (see below) NZGS TM438, paratype NMNZ M.2030, Cook Strait;
Cantharidus opalus cannoni: Holotype AIM AK70133, Kaingaroa, Chatham Islands.

Other material examined: Several hundred specimens in 80 lots NMNZ.

Distribution: (Fig.15). Three Kings, North, South, Stewart, Snares and Chatham Islands, New Zealand, 0-121 m, living on algae from low tide level to 27 m.



Graph 1. Shell width plotted against height in *Cantharidus opalus* (Martyn) from the Chatham Islands (❑) and elsewhere (◆).



Figures 1-14.
Shells of *Cantharidus* species. **1-4,9,12.** *C. opalus* (Martyn). **1.** Neotype (of *Limax opalus*, *Trochus iris* Gmelin and *Trochus acuminatus* Perry), off Matakaoa Point, Hicks Bay, 9-12 m, M.138236 (42.5 x 25.5 mm). **2.** Mollymawk Bay, Snares Islands, 27 m, M.48811 (47.0 x 26.5 mm). **3.** Cape Palliser, M.15907 (38.5 x 28.5 mm). **4.** Taupeka Point, Chatham Islands, 2-5m, M.111872 (50.0 x 36.5 mm). **9, 12.** Early whorls (9) and protoconch (12), Port Pegasus, Stewart Island, 37-44 m, M.44804. **5-7,10,13.** *C. purpureus* (Gmelin). **5.** Aurere Point, Doubtless Bay, M.91727 (19.0 x 12.0 mm). **6.** Neotype (of *Helix purpurea*, *Trochus rostratus* Gmelin, and *Trochus elegans* Gmelin), Port Underwood, Marlborough Sounds, M.138237 (25.3 x 16.0 mm). **7.** Longlookout, Banks Peninsula, M.81219 (26.3 x 19.0 mm). **10.** Early whorls, off Whangaroa, 9-17 m, M.41560. **13.** Protoconch, Waewaetorea Passage, Bay of Islands, 4 m, M.49352. **8,11,14.** *C. burchorum* n. sp. **8.** Southeast Bay, Great Island, Three Kings Islands, 13-15 m, holotype, M.127017 (27.0 x 18.3 mm). **11,14.** Early whorls (11) and protoconch (14), between Great Island and Farmer Rocks, Three Kings Islands, 33 m, paratypes, M.93947. Scale 9-11 = 1 mm, 12-14 = 170 μm.

Remarks: This common, well known species is the type species of *Cantharidus* and the largest living member of Tribe Cantharidini. *Cantharidus opalus* was one of the species obtained by Cook's ship Endeavour, and has the distinction of being the first New Zealand animal to have been illustrated, along with *C. purpureus* (Gmelin, 1791) (Walch, 1774, pl. 1, fig. 6).

Cantharidus opalus is very variable in colour and colour pattern and ranges in shape from narrowly to broadly conical (H/D 1.26-1.81, Graph 1) both within and between populations (Figs 1-4). The most broadly conical specimen seen (H/D 1.26) is from Houghton Bay, Wellington (NMNZ M.1118), the most narrowly conical (H/D 1.81) from The Snares (NMNZ M.48811) (Fig. 2). The holotype and paratype of *C. opalus biangulatus* Suter, 1908 (H/D 1.37 and 1.27) have grown abnormally following damage, as suggested by Suter (1908). Specimens with adult shell morphology range from 27.0-53.0 mm (est.) in height, the largest specimen seen originating from the Chatham Islands (NMNZ M.12297), the smallest from Katiki Beach, Otago (NMNZ M.110853). The whorls may remain weakly convex throughout or the last few whorls may become rather strongly convex. Specimens from the Chatham Islands attain large size and are consistently broadly conical (H/D of mature specimens 1.27-1.43, mean 1.35, SD 0.050, n = 16; as against 1.26-1.81, mean 1.50, SD 0.110, n = 55) (Graph 1, Fig. 4), although some specimens from the North and South islands approach them closely in shape (Fig. 3). Divergence of the Chatham Islands population is presumably the result of response to the local environment and/or geographic isolation. Larval recruitment to the Chatham Islands may have occurred or been facilitated in periods of lowered sealevel during Pleistocene glacial maxima via "stepping-stone" populations on shallow banks on the Chatham Rise. The Chatham Islands form has been interepreted as a subspecies, and some may prefer to use the trinomial *C. opalus cannoni* Powell, 1933 for this local population of *C. opalus*.

C. opalus is rare at the Three Kings Islands, and only a few juveniles and an apertural fragment of a large adult have been seen from there (NMNZ).

In the absence of recognisable type material of *Limax opalus*, *Trochus iris*, and *Trochus acuminatus*, and to obviate confusion with superficially similar species from elsewhere in the world, a single specimen is designated as neotype for all three taxa (Fig. 1). Boreham (1959) selected the specimen of *C. opalus biangulatus* in the Suter collection (NZGS) as "lectotype" because Suter based the variety on two specimens (he did not unequivocally designate holotypes prior to 1914). Suter (1908), however, stated "type in my collection" (now at NZGS), and since the second specimen was in the Bollons collection in the Colonial Museum (now NMNZ), the NZGS specimen must be the holotype rather than a syntype.

Figures 15, 16.
Maps of New Zealand region showing distributions of *Cantharidus* and *Micrelenchus* species: 200 and 1000m contours indicated. **15.** *C. opalus* (Martyn). **16.** *C. purpureus* (Gmelin) (●) and *C. burchorum* n. sp. (★).

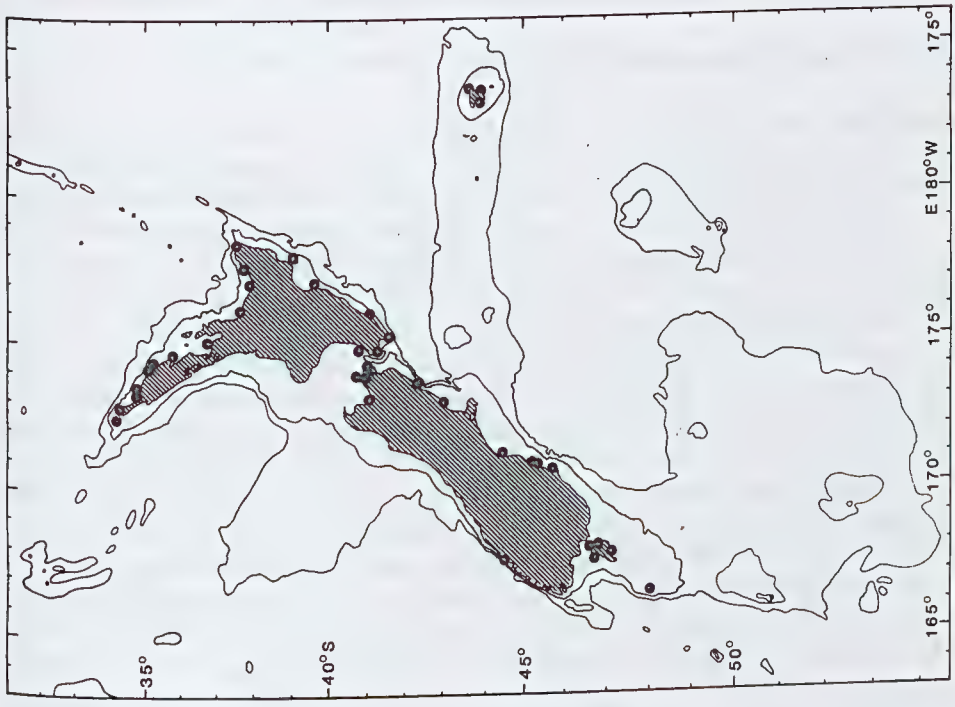


Figure 15

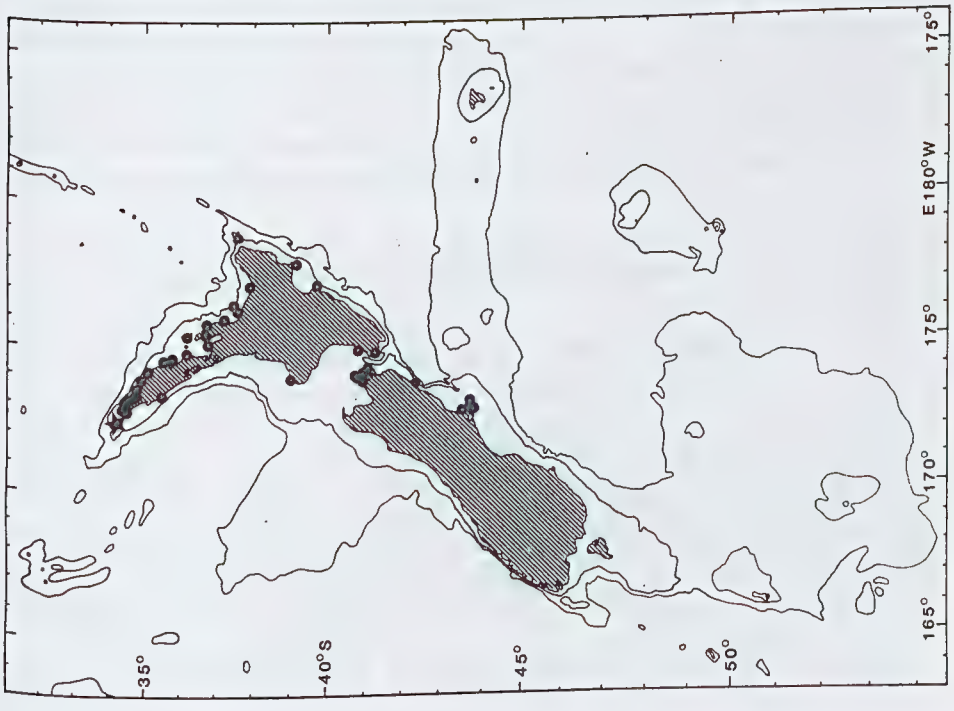


Figure 16

Mawhero new subgenus

Type species: *Helix purpurea* Gmelin, 1791; Recent, New Zealand.

Diagnosis: Shell 20-31 mm high at maturity, very weak flexure at base of inner lip. Teleoconch sculptured with rounded spiral cords and axial riblets or lamellae, spiral cords surmounted by finer spiral cords on later whorls. Left neck lobe digitate. Side of foot strongly papillose. Central radular tooth with narrower tip than in *Cantharidus* (s. str.) and broader tip than in *Micrelenchus*.

Remarks: This new subgenus is introduced for *C. purpureus* (Gmelin, 1791) and *C. burchorum* n. sp. alone, which differ from type species of other genus-groups of Cantharidini in having relatively strong axial sculpture on the early teleoconch coupled with strong spiral cords surmounted by finer spiral cords. The type species of *Thalotia* Gray, 1847 (*Trochus pictus* Wood, 1828 = *Monodonta conica* Gray, 1827; Recent, southern Australia), for example, is superficially similar but differs in having finer, more crowded axial sculpture, nodular spiral cords without secondary spiral sculpture, a stronger flexure at the base of the inner lip, denticles on the inner lip, and much stronger spiral sculpture within the aperture. Although New Zealand and Australian Cantharidini are likely to have common ancestry, it is quite likely that the two regional groups have had independent histories since at least the Early Eocene, when seafloor spreading in the Tasman Sea ceased (commenced Late Cretaceous). The absence in Australia of Cantharidini with sculptural characteristics of *Mawhero* species, suggests that the group originated following isolation of the two faunas. New Zealand Cantharidini have no fossil history prior to the Pleistocene, other than records of a *Cantharidus* species from the Early Miocene, and a Late Oligocene *Micrelenchus* species (Beu and Maxwell, 1990). *Levella* Marwick, 1943 (Early Miocene to Early Pliocene), introduced as a subgenus of *Cantharidus*, is most unlikely to belong in Trochidae, though it probably does belong in Trochoidea (pers. obs.).

Etymology: Mawhero - Pink (Maori), alluding to the common colour of the type species.

Cantharidus (Mawhero) purpureus (Gmelin, 1791)
(Figs 5-7, 10, 13, 16)

?Walch, 1774: 42, pl. 1, fig. 5. Not binomial.
Zorn, 1775: 167, pl. 2, fig. D1, D2. Not binomial.
Chemnitz, 1781:161, fig. 1524, 1525. Not binomial.
Limax purpuratus Martyn, 1784: fig. 68 (rejected name - ICZN op. 479).
Helix purpurea Gmelin, 1791: 3656 (refers to Martyn, 1784, fig. 68).
Trochus rostratus Gmelin, 1791: 3580 (refers to Chemnitz, 1781, fig. 1524, 1525); Kiener, 1850: pl. 46, fig. 1.
Trochus elegans Gmelin, 1791: 3581 (refers to Zorn, 1775, pl. 2, fig. D1, D2); Dillwyn, 1817: 807.

Phasianella rubella Menke, 1828: 28 (refers to *Trochus rostratus* Gmelin, 1791).
Elenchus purpuratus.- Gray, 1843: 239.
Trochus purpuratus.- Philippi, 1847: 10, pl. 2, fig. 9, 10; Fischer, 1879: 366, pl. 112, fig. 3.
Trochus texturatus Gould, 1849: 90; Gould, 1852: 181, pl. 12, fig. 206, a-b; Fischer, 1876: 133, pl. 46, fig. 1.
Trochus torosus Kiener, 1850: pl. 46, fig. 3; Fischer, 1876: 136, pl. 46, fig. 3.
Canthiridus [sic] *purpuratus*.- A. Adams, 1853: 169.
Trochus pallidus Hombron and Jacquinot, 1854: 55, pl. 14, fig. 12, 13.
Cantharidus purpuratus.- Hutton, 1873: 39; Hutton, 1880: 99; Hutton, 1883: 124, pl. 14, fig. o; Hutton, 1884: 361; Pilsbry, 1889: 124, pl. 45, fig. 44; Suter, 1897: 270; Suter, 1913: 126, pl. 39, fig. 7.
Cantharidus elegans.- Hutton, 1873: 39.
Cantharidus texturatus.- Hutton, 1880: 99.
Cantharidus pallidus.- Hutton, 1880: 100.
Cantharidus purpuratus var. *texturatus*.- Pilsbry, 1889: 125, pl. 45, fig. 41-43; Suter, 1897: 270.
Cantharidus purpuratus var. *torosus*.- Pilsbry, 1889: 125, pl. 45, fig. 45.
Cantharidus purpureus.- Powell, 1962: pl. 8, fig. 2; Powell, 1979: 55, pl. 18, fig. 3.

Type data:
Helix purpurea ("New Zealand"), *Trochus rostratus* ("Neu-Seeland") and *Trochus elegans* ("Neuseeland"): Neotype NMNZ M.138237, Port Underwood, Marlborough Sounds, on algae, 1977, M.H.B. O'Neill (Fig. 6);
Trochus texturatus: Syntypes (9), including the originally figured specimen USNM 16518, "New Zealand";
Trochus torosus: Syntypes (2), including the originally figured specimen MNHN, "Nouvelle-Zélande";
Trochus pallidus: Holotype (23.0 x 16.5 mm) MNHN, "Nouvelle-Zélande".
Other material examined: Several hundred specimens in 97 lots NMNZ.

Distribution: (Fig. 16). North Island and South Island as far south as Banks Peninsula, New Zealand, 0-121 m, living on algae from low tide level to 49 m.

Remarks: Cantharidus (Mawhero) purpureus is common throughout its range and characterised by large size (height up to 31 mm) and extremely distinctive teleoconch sculpture. This comprises broad, close, rounded spiral cords (5 on spire, 4 or 5 on base), each of which is surmounted by a number of finer spiral threads, and prosocline, more or less imbricating, collabral axial lamellae between the primary spirals. On the last few whorls of mature specimens the spiral threads typically extend into the interspaces and the axial lamellae extend onto the primary spiral cords. In most specimens the primary spiral cords remain strong throughout, but in others they may become more or less obsolete on the last few adult whorls, though the secondary threads remain (Figs 5-7). Northern shells tend to be more narrowly conical than southern ones. The shell colour is typically either rather uniform pink or shades of green, a combination of these colours, or axially banded, and the early teleoconch whorls are marbled

or axially banded with white. A closely related (allopatric) species occurs at the Three Kings Islands and is described below.

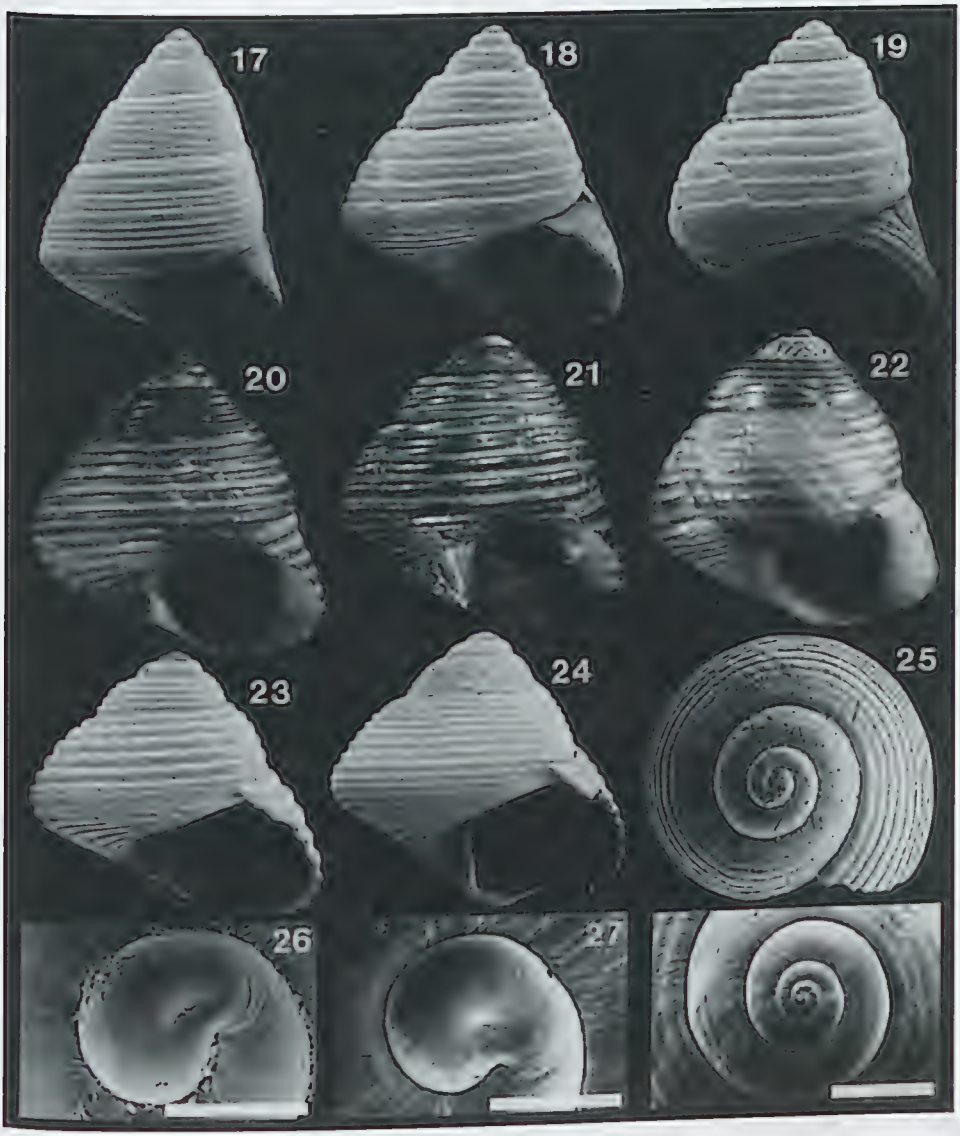
In the absence of recognisable type material of *Helix purpurea*, *Trochus rostratus* and *Trochus elegans*, and to obviate potential confusion with superficially similar species from elsewhere in the world, a single specimen is designated as neotype for all three taxa (Fig. 6).

Cantharidus (Mawhero) burchorum n. sp.
(Figs 8, 11, 14, 16)

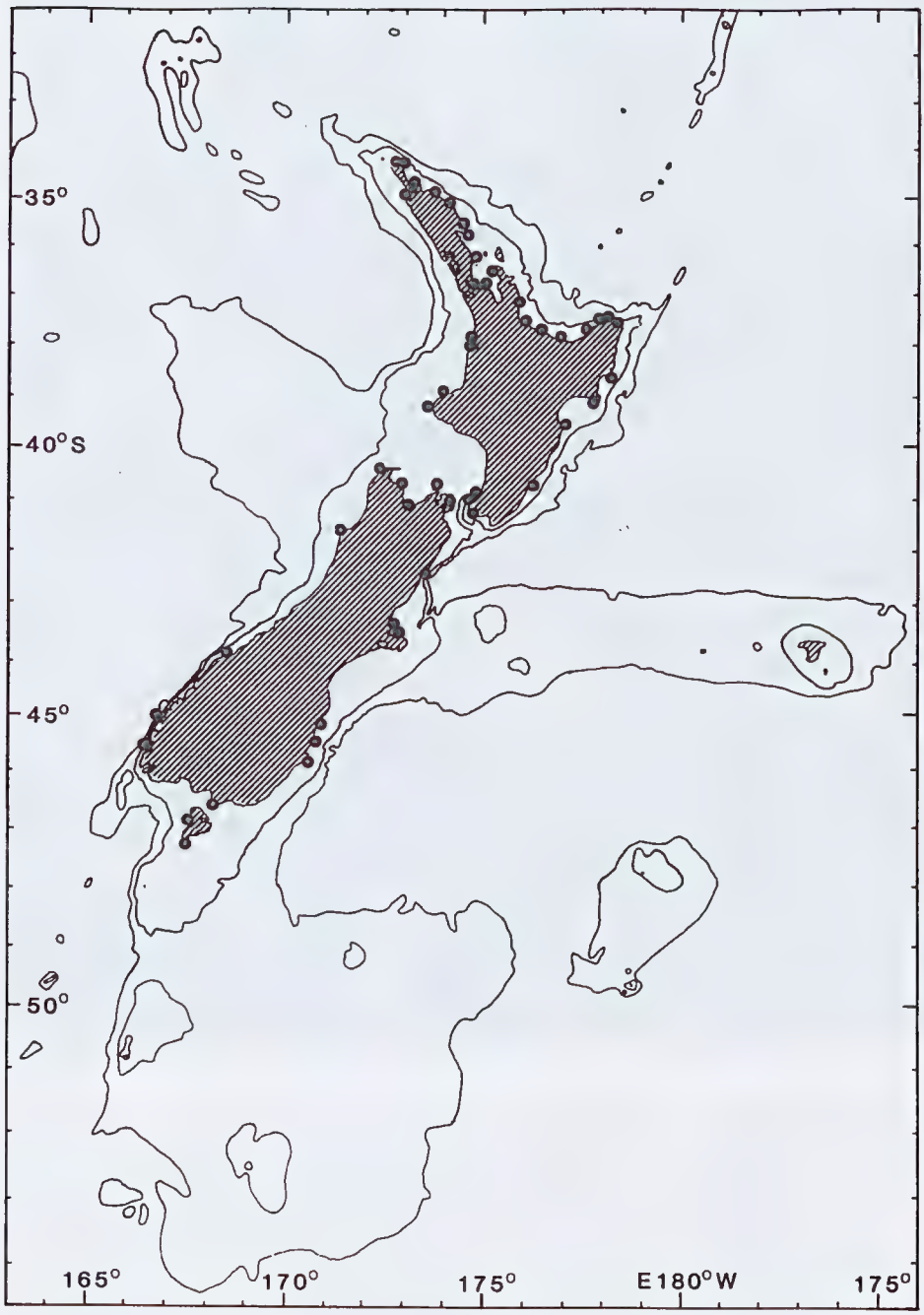
Description: Shell 20.5-27.5 mm high at maturity, weakly cyrtoconoid, higher than broad, stout, glossy, anomphalous, height/diameter ratio 1.42-1.55. Protoconch white. First teleoconch whorl pink, second whorl and first half of third whorl alternately axially maculated with pink and white; next few whorls predominantly pink, variably spotted and axially banded with combinations of lighter and darker shades of pink and white, occasional specimens with addition of green or lavender spots; last few whorls rather uniform dull pink or dull greenish pink, grading to pale, milky green on last whorl or penultimate whorl in adults; spiral interspaces more deeply pigmented than primary spiral cords on last few adult whorls. Protoconch 250 μm wide, smooth, tip narrowly pinched. Teleoconch with up to 8 convex whorls, periphery broadly rounded, base weakly convex. Primary spiral cords rounded, 5 on spire whorls and 5 on base, adapical spiral at first weaker than others but gradually enlarging to resemble them, abapical spire spiral peripheral and almost entirely covered by succeeding whorls, all about as high as broad with interspaces about as wide as each spiral on early whorls, progressively lowering and broadening until almost obsolete, interspaces on last few adult whorls almost imperceptible and defined by differential pigmentation. Primary spirals simple on first 4 whorls, then surmounted by finer, similar secondary spiral threads that commence on fifth whorl and multiply by intercalation to number 5-9 on each primary spiral, covering last few whorls at maturity. Axial riblets commencing on fourth whorl, rounded; interstitial, narrow with broader interspaces at first, progressively broadening until separated by shallow, narrow grooves that traverse last few whorls at maturity. Aperture ovate, lips simple, insertion of outer lip descending slightly at maturity.

Type data: Holotype NMNZ M.127017, and 3 paratypes M.100396, Southeast Bay, Great King Island, Three Kings Islands, alive on algae, 13-15 m, scuba K. Burch, May 1988. Paratypes (NMNZ): Tasman Bay, Great King Island, alive on algae, scuba, A.N. Baker, J. Moreland and B. Stephenson, 19 February 1974 (2, M.36071); Northwest Bay, dead, 5-7 m, scuba G.S. Hardy and A.L. Stewart, 30 November 1983 (7, M.75137); Princes Rocks, alive, 15 m, G.S. Hardy and A.L. Stewart, 2 December 1983 (1, M.75140); Princes Rocks, alive, 18 m, scuba K. Burch, 1993 (1, M.117893); reef between Great Island and Farmer Rocks, dead, 33 m, scuba G.S. Hardy, 17 February 1983 (many juveniles, M.93947).

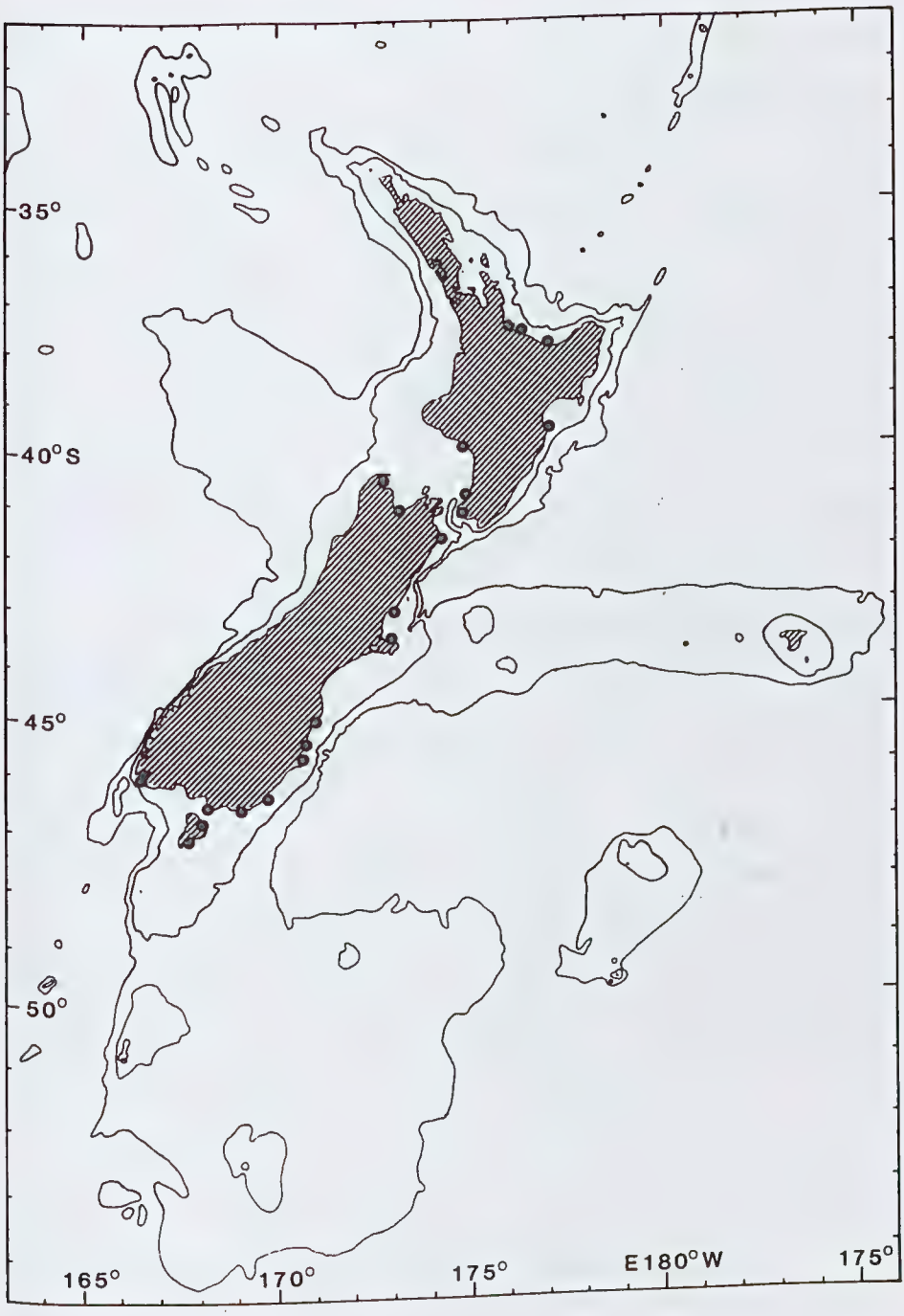
Other material examined: >100 specimens from 15 stations off Three Kings Islands, Middlesex Bank and King Bank, mostly juveniles (NMNZ).



Figures 17-28.
Shells of *Micrelenchus* species. **17-19,26.** *M. sanguineus* (Gray). **17.** Ti Point, Leigh, littoral, M.21440 (10.50 x 8.00 mm). **18.** Breaker Bay, Wellington, on littoral *Carpophyllum*, M.17103 (7.00 x 6.40 mm). **19.** Shag Point, Otago, under *Durvillea* holdfasts, low tide, M.17111 (7.10 x 6.00 mm). **26.** Protoconch, Reef Point, Ahipara, littoral, M.130021. **20-23,27,28.** *M. tenebrosus* (A. Adams). **20.** Shag Point, Otago, under *Durvillea* holdfasts, low tide, M.16485 (9.50 x 9.00 mm). **21.** Marfell's, Beach, Cape Campbell, littoral, M.84314 (7.70 x 7.60 mm). **22.** Butterfield Beach, Paterson Inlet, Stewart Island, littoral, M.64546 (9.40 x 9.00 mm). **23.** Subadult, Porirua Harbour entrance, littoral, M.127137 (4.10 x 4.70 mm). **27,28.** Protoconch (27) and early spire whorls, Halfmoon Bay, Paterson Inlet, Stewart Island, littoral, M.71061. **24,25.** *M. huttonii* (Smith). **24.** Subadult, Pauatahanui, Paremata Harbour, littoral, M.44135 (5.90 x 6.40 mm). **25.** Potato Point, Otago Peninsula, littoral, M.109176 (width 2.00 mm). Scale 26, 27 = 170 μm, 28 = 500 μm.



Figures 29.
Maps of New Zealand region showing distributions of *Micrelenchus* species: 200 and 1000 m contours indicated. **29.** *M. sanguineus* (Gray).



Figures 30.
Maps of New Zealand region showing distributions of *Micrelenchus* species: 200 and 1000 m contours indicated. **30.** *M. tenebrosus* (A. Adams).

Distribution: (Fig. 16). Off Three Kings Islands, Middlesex Bank and King Bank, northern New Zealand, 7-805 m, taken alive from algae at 13-18 m. Restricted endemic.

Remarks: Cantharidus (Mawhero) burchorum differs from the allopatric species *C. purpureus* in that the axial riblets are rounded throughout and do not at any stage become crisp imbricating lamellae, and in that the second to fifth teleoconch whorls are far more brightly, extensively and variably coloured and patterned, as opposed to axially maculated in shades of pink (predominantly) or green on a white ground, the pigmentation being typically confined to the summits of the spiral cords in *C. purpureus*. In most specimens of *C. purpureus* the primary spiral cords and axial lamellae remain strong onto the last adult whorl, though occasional specimens undergo sculptural transformation on the last few adult whorls as in *C. burchorum* (Fig. 7). Note that the most extreme of the latter forms of *C. purpureus* are from Banks Peninsula, at the southern limit of the geographic range.

C. burchorum joins a considerable number of mollusc species endemic to the Three Kings Islands. Additional endemic Three Kings trochids, are known (Marshall, in prep.). Although situated only about 57 km north-west of Cape Reinga, the Three Kings Islands support a large number of restricted endemic species, due to isolation by bathymetry, strong eastward tidal flow, and locally cool sea temperature and decreased salinity due to upwelling (Stanton, 1973). Powell (1937) described a rich molluscan fauna from 92-260 m depth off the Three Kings Islands, comprising 214 species, of which 124 (60%) were new to science, and a high proportion of which appear to be restricted endemics. Additional endemics or apparent endemics from depths greater than 50m have been described by Crozier (1966), Marshall (1977, 1978, 1979, 1983, 1988, 1993, 1995a, b), Ponder (1965a, b, 1968), and Powell (1940 - includes summary of earlier records). The molluscan fauna from depths shallower than 50 m is also rich in endemic species, very few of which, however, have been named (Marshall, 1995b; Willan, 1978, 1988). From an unpublished study, F.J. Brook (pers. comm.) estimated molluscan endemism at the Three Kings Islands to be in the order of 15-20% among the more than 400 species (NMNZ) now known to occur there at depths shallower than 50 m. There are also a number of endemic algae, including a species of *Sargassum* and the monotypic genus *Perisporochnus* (Adams and Nelson, 1985). Whereas endemism is high among shelled Mollusca, it is low in nudibranchs (Willan, 1988) and there are no endemic fishes (C.D. Paulin and A.L. Stewart, pers. comm.). Some of the species endemic to the Three Kings Islands and off the extreme tip of the North Island between Cape Maria van Diemen and North Cape, are related to species that were more widely distributed in the New Zealand region during the Pliocene (e.g. *Venericardia reinga* Powell, 1933, *Gomphina maorum* Smith, 1902, and *Sigapatella superstes* Fleming, 1958) (Fleming, 1958), or that currently live in cooler waters to the south (e.g. *Kidderia aupouria* Powell, 1933, *Perrierina substriata* Powell, 1935, *Calliostoma (Maurea) jamiesoni* Marshall, 1995, and *C. (M.) gibbsorum* Marshall, 1995). Some of the latter may be descended from ancestors that range-expanded northwards during glacial maxima. Fleming (1958) considered that relict species

survived in the extreme north because the sea is warm there, but the converse is more likely since they are absent from the warmer waters of north-eastern Northland. The Three Kings Islands support a far higher number and proportion of endemic marine Mollusca than the Chatham Islands or the subantarctic islands, which are at considerably greater distance from mainland New Zealand and from each other.

Etymology: After Kevin and Judy Burch of Whangarei, who provided the holotype, and in recognition of their fostering of amateur malacology in New Zealand.

Genus **Micrelenchus** Finlay, 1926

Gibbium Gray, 1843: 238.
Type species (monotypy): *Trochus sanguineus* Gray, 1843; Recent, New Zealand.
Not *Gibbium* Scopoli, 1777.
Micrelenchus Finlay, 1926: 355.
Type species (by original designation): *Trochus sanguineus* Gray, 1843; Recent, New Zealand.

Diagnosis: Shell small (height 3.40-28.70 mm at maturity), slightly higher than broad, narrowly umbilicate or (most species) anomphalous. Teleoconch sculptured with rounded spiral cords, with or without interstitial axial riblets. Three pairs of relatively large epipodial tentacles. Left neck lobe strongly digitate or smooth. Side of foot weakly pustulose. Central radular tooth with narrow tip and relatively short lateral projections.

Remarks: Micrelenchus was interpreted as a subgenus of *Cantharidus* by Thiele (1929), Wenz (1938) and Keen (1960), though local workers and Hickman and McLean (1990) have treated them as distinct genera. Apart from smaller shell size, species here referred to *Micrelenchus* differ in having relatively larger epipodial tentacles, and in that the central radular tooth has a much more narrowly tapered tip (Figs 82-84). *Micrelenchus* species are here referred to *Micrelenchus* (s. str.) and subgenus *Plumbelenchus*, both of which appear to be local (endemic) radiations within the New Zealand region.

Subgenus **Micrelenchus** Finlay, 1926

Diagnosis: Shell small (height 4.10-15.00 mm at maturity). Teleoconch sculptured without interstitial axial riblets. Left neck lobe strongly digitate.

Micrelenchus (Micrelenchus) sanguineus (Gray, 1843)
(Figs 17-19, 26, 29, 84)

Trochus (Gibbium) sanguineus Gray, 1843: 238.
Trochus (Gibbula) sanguineus.- Smith, 1874: 4, pl. 1, fig. 12.
Cantharidus pupillus (Gould).- Hutton, 1880: 100; Hutton, 1884: 362; Pilsbry, 1889:

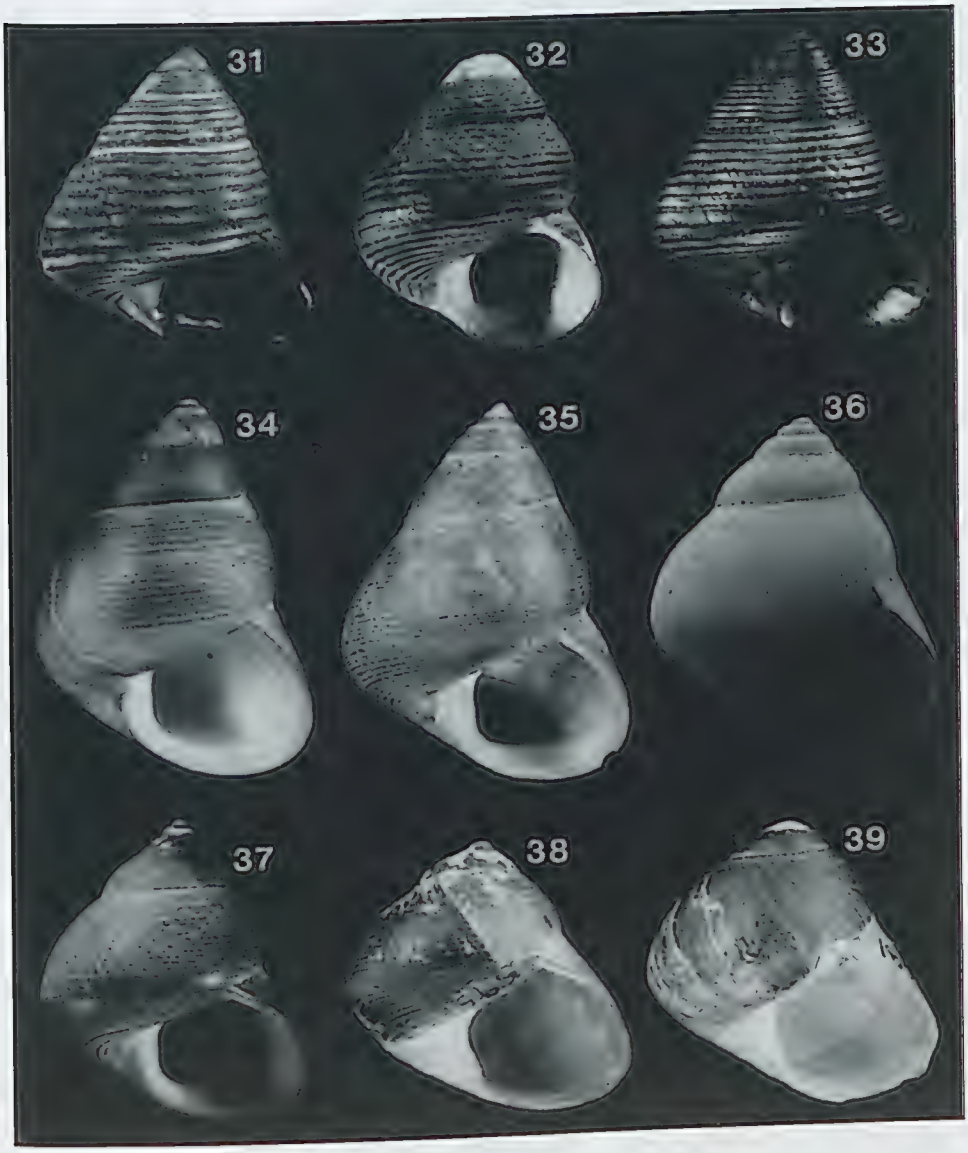
130; Suter, 1897: 270, text fig.; Suter 1913: 126, pl. 33, fig. 7 (not *Trochus pupillus* Gould, 1849).
Cantharidus sanguineus.- Hutton, 1884: 362; Pilsbry, 1889: 131, pl. 47, figs 92, 93; Suter, 1897: 271, in part = *M. mortenseni*, text fig. = *M. caelatus*; Suter, 1913: 128, in part = *M. mortenseni*, pl. 33, fig. 8 = *M. caelatus*.
Cantharidus oliveri Iredale, 1915: 438 (new name for *C. pupillus* Suter, 1913 not *Trochus pupillus* Gould, 1849).
Micrelenchus sanguineus.- Finlay, 1926: 355.
Micrelenchus oliveri.- Powell, 1946b: 138, pl. 11, fig. 8.
Micrelenchus oliveri cryptus Powell, 1946b: 139, pl. 11, fig. 7. New synonym.
Micrelenchus sanguineus sanguineus.- Fleming, 1951: 136, pl. 18, fig. 3, pl. 20, fig. 3; Boreham, 1959: 26; Powell, 1979: 57, pl. 18, figs 7, 8.
Micrelenchus sanguineus cryptus.- Fleming, 1951: 137; Powell, 1979: 57, pl. 18, fig. 13.
NOT *Cantharidus sanguineus*.- Suter, 1897: 272 text fig. (only); Suter, 1913: pl. 33, fig. 8 (only) = *M. caelatus*.
NOT *Micrelenchus sanguineus*.- Finlay, 1928: 238 = *M. mortenseni*.
NOT *Cantharidus (Micrelenchus) sanguineus*.- Wenz, 1938: 303, fig. 670 = *M. caelatus*.
NOT *Micrelenchus sanguineus sanguineus*.- Fleming, 1948: 85, pl. 7, fig. 13 = *M. artizona*.

Type data:
Trochus (Gibbium) sanguineus: Lectotype ("holotype" Fleming, 1951) BMNH 1842.11.16.125 (6.60 x 6.00 mm) and 1 paralectotype BMNH 1842.11.16.126, "New Zealand, Dr Stanger" on tablet, type locality here designated as Takapuna Reef, Auckland;
Cantharidus oliveri: Lectotype (Boreham, 1959) NZGS TM450, Takapuna, Auckland;
Micrelenchus oliveri cryptus: Holotype AIM AK71040, 6.4 km south of Clarence River mouth, Marlborough.

Other material examined: >500 specimens in 94 lots NMNZ.

Distribution: (Fig. 29). North, South and Stewart islands, New Zealand, 0-13 m, common living on algae intertidally to at least 13 m, and from under *Durvillea* holdfasts at low tide.

Remarks: This common, widely distributed species is variable in size, shape and sculpture, and exceedingly variable in colour and colour pattern. The spiral cords, which multiply by division, are broad, smooth and polished. Mature specimens range from 4.10 to 10.80 mm in shell height. Height diameter ratio of mature specimens ranges from 0.98 to 1.32, the highest specimens occurring north of East Cape, the lowest being southern shells and small adults from throughout the range. Adult specimens from north of Castlepoint typically have six to eight (rarely up to 10) spiral cords on the penultimate whorl at maturity, whereas specimens from Kaikoura and southward have four to six.



Figures 31-39.
Shells of *Micrelenchus* species. **31-33.** *M. huttonii* (Smith). **31.** Mill Bay, Manukau Harbour, littoral, M.15386 (11.50 x 9.50 mm). **32.** Potato Point, Otago Peninsula, littoral, M.109176 (10.80 x 9.00 mm). **33.** Ngawhakawhita Bay, Tennyson Inlet, Marlborough, littoral, M.138214 (neotype of *Gibbula plumbea* Hutton, 10.50 x 9.50 mm). **34-39.** *M. capillaceus* (Philippi). **34.** Perseverance Harbour, Campbell Island, M.10111 (16.10 x 12.00 mm). **35.** Hanfield Inlet, Auckland Island, M.8351 (27.00 x 19.00 mm). **36.** Juvenile, Auckland Islands, 20m, NZOI stn. D65 (5.10 x 4.55 mm). **37.** Derry Castle Reef, Enderby Island, Auckland Islands, M.S. Morley colln (21.00 x 17.20 mm). **38.** Off Archway Island, Antipodes Islands, 15 m, M.59535 (18.6 x 18.5 mm). **39.** Garden Cove, Macquarie Island, M.218046 (19.00 x 19.00 mm).

Specimens from north of Castlepoint have weakly convex spire whorls and a narrowly rounded periphery, whereas specimens from south of Kaikoura have markedly convex whorls and a more broadly rounded periphery. Specimens from geographically intermediate localities, particularly the Wellington area, typically have six or seven cords on the penultimate whorl, and intergrade in shape (Fig. 18).

Since the southern form smoothly intergrades with the nominate northern one in the area between Castlepoint and Kaikoura, there is no point in maintaining *cryptus* as a geographic subspecies.

M. sanguineus is known from north of Cape Reinga by a single worn specimen (NMNZ M.119167), which occurred in a sample of sand and old-looking worn shells from a current-swept bottom at 121 metres depth. This sample included abundant worn specimens of *M. rufozona*, which apparently lived there when the sea was lower and cooler than at present (see below). The specimen of *M. sanguineus* is accordant with this interpretation because it more closely resembles the low, heavily sculptured southern *cryptus* form than any extant North Island shells.

The specimen discussed and illustrated by Fleming (1951) as "holotype" of *M. sanguineus* is actually one of two syntypes that have since been separated from a tablet (retained with the types), so he effectively selected it as lectotype. The lectotype and paralectotypes are perfectly accordant with specimens from Takapuna Reef, Auckland, which is here designated as the type locality. The specimen illustrated by Suter (1897, 1913 - the latter illustration is a poor engraver's rendition of the former) as "*Cantharidus sanguineus*" clearly represents *M. caelatus*, and was probably from Suter Collection lot 1301 (NZGS, 5.50 x 4.70 mm).

Iredale (1915) introduced *C. oliveri* explicitly "for the species described by Suter [1913, p. 126] under the name *Cantharidus pupillus* Hutton, 1884". Whereas Suter (1913) *described* both North Island and South Island shells, he illustrated what is clearly a North Island one. Powell (1946) selected a North Island shell (Takapuna) as "neotype" of *M. oliveri*, but since this specimen was not among the material referred to by Suter, Boreham (1959) correctly designated a specimen in the Suter collection (NZGS) as lectotype. The dimensions of this specimen closely match the published measurements, though as noted by Boreham (1959) it is not the figured specimen. Again, Suter's (1913, pl. 33, fig. 7) illustration is a crude plate-maker's reproduction of an earlier, more life-like rendition (Suter, 1897, p. 271, text fig.). A sample of eight specimens from Lyttelton in the Canterbury Museum (M.9929) labelled as both "*Cantharidus pupillus* Hutton....type" and "= syntypes of *Cantharidus oliveri* Iredale, 1915" represent the *cryptus* form, as do specimens identified as *Cantharidus pupillus* (Gould, 1849) "from Bank's Peninsula to Dunedin" from Hutton's collection (NMNZ M.1050). There is no reason to doubt that the Canterbury Museum specimens are syntypes of *M. oliveri*, but they have no type status with respect to *Cantharidus pupillus*, since Hutton (1880) was merely using Gould's name.

Micrelenchus (Micrelenchus) tenebrosus (A. Adams, 1853)
(Figs 20-23, 27, 28, 30)

Canthiridus [sic] *tenebrosus* A. Adams, 1853: 170.
Gibbula dolorosa Tenison Woods, 1877: 143; Tate and May, 1901: 404, 446, pl. 24, fig. 31.
?Trochus (Gibbula) scamnatus Fischer, 1878: 66.
Thalotia dolorosa.- Tenison Woods, 1878: 41.
?Trochus scamnatus.- Fischer, 1879: 394, pl. 117, fig. 4.
Cantharidus tenebrosus.- Hutton, 1880: 101; Hutton, 1884: 361, Pilsbry, 1889: 123, pl. 34, fig. 3; Suter, 1897: 269 (in part = *M. huttonii*).
Gibbula scamnata.- Pilsbry, 1890: 220, pl. 30, fig. 6; Suter, 1897: 278; Suter, 1913: 138, pl. 38, fig. 23.
Cantharidella dolorosa.- Hedley, 1920: 54.
Micrelenchus tenebrosus.- Finlay, 1926: 370; Finlay, 1928: 238; Dell, 1963: 175, fig. 13.
Micrelenchus parcipictus Powell, 1946a: 138, pl. 11, fig. 1; Powell, 1979: 56, pl. 18, fig. 12. New Synonym.
Micrelenchus tenebrosus.- Powell, 1976: 83, pl. 15, fig. 5; Powell, 1979: 57, pl. 18, fig. 9 only (in part = *M. huttonii*).

Type data:
Canthiridus tenebrosus: Lectotype (10.2 x 8.50mm, here selected) BMNH 196854/1 and 1 paralectotype BMNH 196854/2, described from unknown locality, type locality here designated as Cape Campbell;
Gibbula dolorosa: Holotype Tasmanian Museum, Hobart TM5532, "Bass' Straits" = New Zealand;
Trochus (Gibbula) scamnatus: Type material apparently no longer extant, not at MNHN (V. Heros, pers. comm.),"Oceania";
Micrelenchus parcipictus: Holotype AIM AK71041, Sealer's Beach. between Otago's Retreat and Puysegur Point, Fiordland, under stones, low tide.

Other material examined: >600 specimens in 49 lots NMNZ.

Distribution: (Fig. 30). North Island as far north as Tauranga, South Island and Stewart Island, New Zealand, 0-446 m; living under clean rocks at low tide on exposed coasts, or (Tauranga Harbour) possibly on shell banks in harbour channels. Common, but local south of Cape Egmont. Unknown living (extinct?) north of Wanganui.

Remarks: Micrelenchus tenebrosus is rather variable in adult size, shape, colour, colour pattern, and in the size and number of spiral cords (6-8 on penultimate whorl, 6-10 on base) (figs 20-23). The largest specimens seen are from Stewart Island (height up to 11.50mm), whilst the smallest adults are from the east coast of the North Island (largest 6.90 mm high). The umbilicus remains open at all stages of growth in most specimens from throughout the geographic range, though it may become closed through over-growth by the inner lip in some narrowly conical specimens. The early teleoconch whorls are at first axially banded then marbled on a paler ground. Later whorls are shades of olive green, grey or brown, rarely with irregular axial maculations or bands. The spiral cords are typically more deeply pigmented than the interspaces, and may be

uniformly pigmented or spotted. *M. tenebrosus* has an extremely patchy distribution (Fig. 30), and is generally rare (shells only - extinct?) north of Wanganui though well preserved shells wash ashore in Tauranga Harbour and at Mount Maunganui, and have been obtained in considerable numbers together with *M. rufozona* from suction dredge spoil from extensions to the Port of Tauranga container wharf (M.119945). Although the species has not been taken alive in Tauranga Harbour (despite intensive searching for it intertidally and by dredging by myself and N.J. Peterson), it is possibly still living there subtidally on shell banks in the channels.

Finlay's (1928) Chatham Islands record, based on a single poorly preserved shell (AIM AK14826), requires confirmation as the species has not been recollected there (locally extinct?).

The syntypes of *C. tenebrosus* most closely resemble specimens from Cape Campbell in shape, size and sculpture, and the specimen selected as lectotype is the shell illustrated by Dell (1963, pl. 2, fig. 13). *M. parcipictus* is based on strongly patterned specimens from Puysegur Point, which otherwise fall within the range of variation of *M. tenebrosus* from East Otago, Preservation Inlet and Stewart Island. Contrary to Powell's (1946) statement, the umbilicus remains open at maturity in all but the most narrowly conical specimens. For additional remarks, see under *M. huttonii* (below).

Suter's (1897, 1913) records of *Gibbula scamnata* (Fischer, 1878) are based on typical, well preserved specimens of *M. tenebrosus* from Te Onepoto and Brighton (Suter collection, NZGS). In the absence of type material, and from the original description and subsequent illustration (Fischer, 1878, 1879), it is impossible to be sure whether or not *Trochus scamnatus* is really a synonym of *M. tenebrosus* as implied by Hedley (1920), who placed it as a synonym of *Gibbula dolorosa* Tenison Woods, 1877 (= *M. tenebrosus*). Suter's material identified as *Cantharidus tenebrosus* includes specimens of *M. huttonii* (NZGS, Suter colln. 1326, 2647).

Micrelenchus (Micrelenchus) huttonii (Smith, 1876)
(Figs 24, 25, 31-33, 40)

Gibbula nitida.- Hutton, 1873: 40 (not A. Adams and Angas, 1864).
Trochus (Canthiridus) [sic] *huttonii* Smith, 1876: 558, pl. 30, fig. 20.
Gibbula plumbea Hutton, 1878: 33 (new name for *Gibbula nitida* Hutton, 1873 not A. Adams and Angas, 1864).
Cantharidus huttonii.- Hutton, 1880: 100.
Cantharidus tenebrosus.- Suter, 1897: 269 (in part); Suter, 1913: 129 (in part)
Cantharidus tenebrosus var. *huttonii*.- Hutton, 1884: 362; Pilsbry, 1889: 123, pl. 34, fig. 2; Suter, 1897: 269.

Figures 40, 41.
Maps of New Zealand region showing distributions of *Micrelenchus* species: 200 and 1000 m contours indicated. **40.** *M. huttonii* (Smith). **41.** *M. capillaceus* (Philippi). Solid stars - living populations, open star - subrecent shells, A - Auckland Islands, An - Antipodes Islands, B - Bounty Islands, C - Campbell Island, Ch - Chatham Islands, M - Macquarie Island, S - Snares Islands. Arrows denote general oceanic circulation pattern within the distribution range.

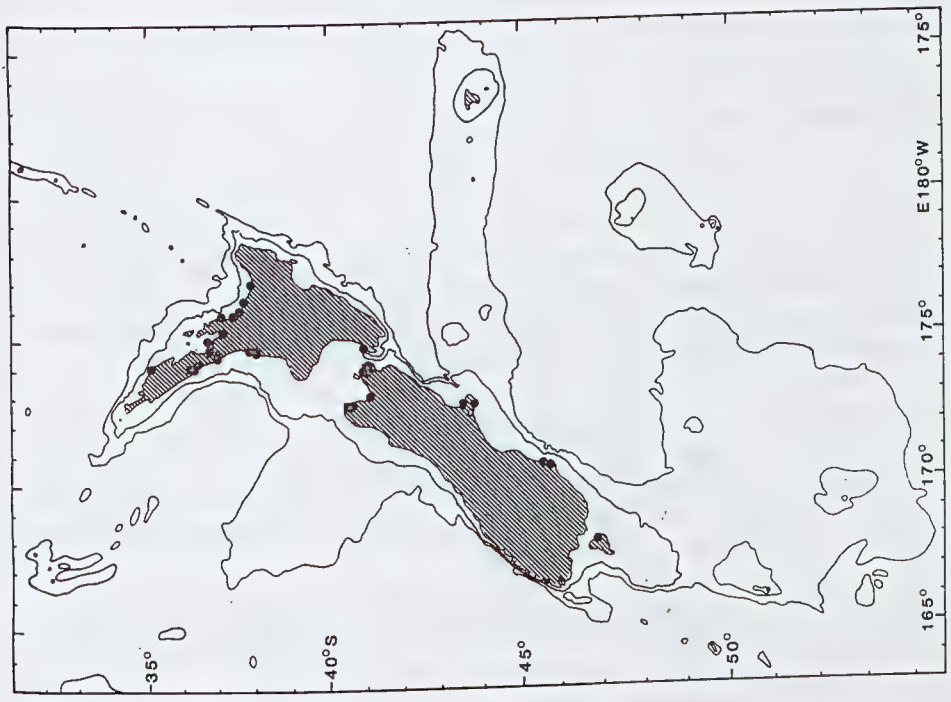


Figure 40

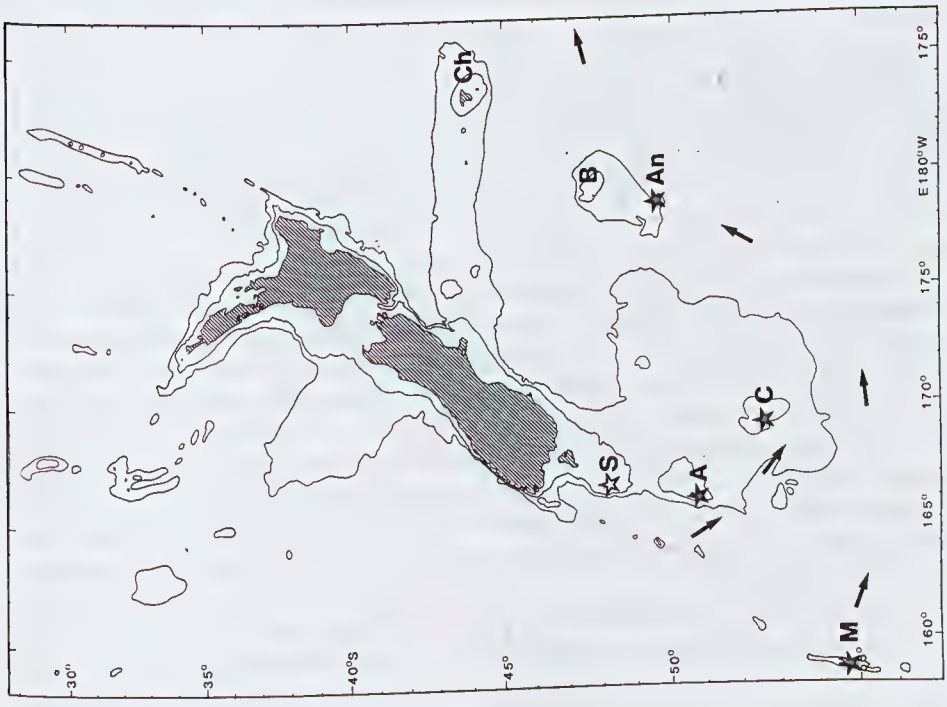


Figure 41

Cantharidus tenebrosus huttoni.- Suter, 1913: 129, pl. 38, fig. 16.
Micrelenchus tenebrosus huttoni.- Finlay, 1926: 370; Finlay, 1928: 238.
Micrelenchus huttoni.- Dell, 1963: 175, pl. 2, fig. 12.
Micrelenchus tenebrosus.- Powell, 1976: 83, pl. 15, fig. 5; Powell, 1979: 57, pl. 18, fig. 14 only (in part).

Type data:
Trochus (Canthiridus) huttonii: Lectotype (here selected: 14.0 x 12.1 mm) BMNH 1994021/1 and 3 paralectotypes BMNH 1994021/2-4, "New Zealand", type locality here designated as Stewart Island (see below);
Gibbula plumbea: Neotype here selected, NMNZ M.138214, Ngawhakawhita Bay, Tennyson Inlet, Marlborough, December 1956, W.F. Ponder (Fig. 33).

Other material examined: Several hundred specimens in 49 lots NMNZ.

Distribution: (Fig. 40) North Island as far north as Bay of Islands, South Island and Stewart Island, New Zealand, 0-7 m, living on intertidal mudflats and locally in sheltered intertidal rock pools.

Remarks: Micrelenchus huttonii has been mistakenly interpreted as an ecotype of *M. tenebrosus* (Powell, 1976; Walsby and Morton, 1982). Both species are very variable in shape and size, and in the size and number of spiral cords, and both have brown axial bands on a paler ground on the earliest teleoconch whorls, though not all populations of *M. huttonii* have them. Compared with *M. tenebrosus*, the shell of *M. huttonii* differs principally in attaining larger size (height up to 15.00 mm instead of 11.50 mm), in that the spiral cords commence at the start of the second teleoconch whorl instead of after the second whorl, in that the shell is thinner at equivalent size, and in that the inner edge of the rim of the outer lip is black at maturity. The shell of *M. huttonii* is almost invariably lustreless due to solution etching, but it is typically glossy in *M. tenebrosus*. The spiral cords are very variable in width and the interspaces may be wider than each spiral or much narrower. They range in number from six to nine on the penultimate whorl (lowest partly covered by the last whorl) and eight to thirteen on the base in adults. Despite variation in the width of the spiral cords in both species, they are typically higher with correspondingly deeper interspaces in *M. tenebrosus*, consistently so in North Island populations. Specimens of *M. huttonii* from south of the Firth of Thames typically have dark grey to intense black spiral cords with paler interspaces, whereas northern populations typically include a proportion of paler specimens with some or all spiral cords alternately lightly and darkly spotted. The head and side of the foot in *M. huttonii* are uniform intense black, whereas *M. tenebrosus* has longitudinal and transverse lines on the side of the foot, and transverse lines on the dorsal surface of the head.

M. huttonii and *M. tenebrosus* have almost fully overlapping geographic ranges but have different ecological preferences. *M. huttonii* is abundant on estuarine *Zostera* flats and locally in sheltered rock pools (e.g. Governors Bay, Banks Peninsula NMNZ M.17176; Potato Point, Otago Peninsula, NMNZ

M.109176). *M. tenebrosus* lives under clean stones on exposed rocky shores, though in Tauranga Harbour it apparently lives or lives on clean sand and shell in channels.

Finlay's (1928) record of *M. tenebrosus huttoni* from the Chatham Islands, based on 2 beach shells (AIM AK14825), requires confirmation as the species has not been recollected there (locally extinct?).

Of the four syntypes (BMNH), the two larger resemble Stewart Island shells in shape and size, whilst the two smaller are definitely from the North Island, possibly Tauranga Harbour. The specimen chosen as lectotype (Stewart Island) seems most likely to have been the subject of the original illustration, and the given dimensions ("Alt. $14^1/_2$ mill., diam. $10^1/_2$ ") are accordant. Potential syntypic material of *G. plumbea* labelled in Hutton's handwriting could not be traced. Since Hutton (1880) regarded *G. plumbea* as a synonym of *C. huttonii*, and clearly differentiated between *C. huttoni* and *C. tenebrosus*, a specimen of *M. huttonii* is selected as neotype of *G. plumbea*.

Note that the original spelling of the specific epithet was *"huttonii"*, and *"huttoni"* is an incorrect subsequent spelling (ICZN art. 33d).

Subgenus **Plumbelenchus** Finlay, 1926

Plumbelenchus Finlay, 1926: 356.
Type species (by original designation): *Trochus capillaeus* Philippi, 1848; Recent, southern New Zealand.

Diagnosis: Shell small (height 3.40-28.70 mm at maturity), slightly higher than broad, anomphalous. Teleoconch sculptured with rounded spiral cords, with or without interstitial axial riblets. Three pairs of relatively large epipodial tentacles. Left neck lobe smooth. Side of foot weakly pustulose. Central radular tooth with narrow tip and narrow lateral projections.

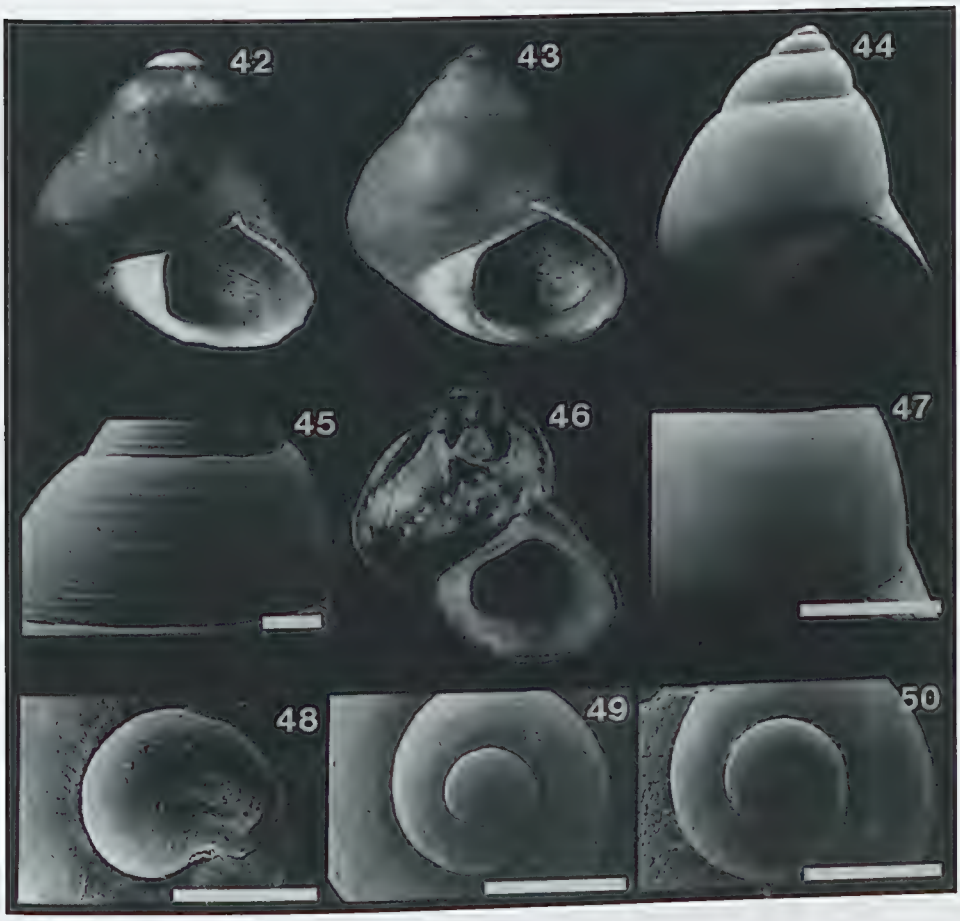
Remarks: Species here referred to *Plumbelenchus* differ from species of *Micrelenchus* (s. str.) in that the left neck lobe is smooth instead of digitate. Moreover, *M. dilatatus* and *M. festivus* n. sp. are closer to *M. (P.) capillaceus* than to species of *Micrelenchus* (s. str.) in gross shell morphology (Figs 34-37, 42-47), and there is a rather fluid morphological transition between species with many weak spiral cords and those with few strong ones via *M. artizona*. All *Micrelenchus (Plumbelenchus)* species other than *M. (P.) capillaceus*, *M. (P.) dilatatus* and *M. (P.) festivus* have crowded interstitial axial riblets, unlike species of *Micrelenchus* (s. str.) in which interstitial axial sculpture is lacking. *Plumbelenchus* has consistently been treated as a subgenus of *Cantharidus*, primarily because the type species is larger than species formerly referred to *Micrelenchus*. The type species, however, more closely resembles *Micrelenchus* species in shell and radular morphology than it does *C. opalus*. Since *Micrelenchus* and *Cantharidus* are here treated as distinct genera, *Plumbelenchus* is interpreted as a subgenus of *Micrelenchus*.

Micrelenchus (Plumbelenchus) capillaceus (Philippi, 1849)
(Figs 34-39, 41, 42, 48, 83)

Trochus (Osilinus?) capillaceus Philippi, 1849: 102.
Trochus pruninus Gould, 1849: 90; Gould, 1852: 180, pl. 12, fig. 205a, b.
Canthiridus [sic] *zealandicus* A. Adams, 1853: 169; Hutton, 1880: 99.
Trochus episcopus Hombron and Jacquinot, 1854: 55, pl. 14, fig. 9-11; Kiener, 1850: pl. 52, fig. 3.
Trochus capillaceus.- Philippi, 1855: 275, pl. 40, fig. 7; Fischer, 1877: 161, pl. 52, fig. 3.
Cantharidus episcopus.- Hutton, 1880: 100.
Cantharidus pruininus [sic].-Pilsbry, 1889: 122, pl. 46, fig. 60, 61.
Cantharidus pruninus var. *minor* Smith, 1902: 207.
Cantharidus pruninus.- Hutton, 1884: 361; Suter, 1898: 268; Suter, 1913: 125, pl. 39, fig. 5.
Cantharidus pruininus [sic] var. *perobtusa* Pilsbry, 1889: 123, pl. 34, fig. 1.
Cantharidus pruninus var. *perobtusa*.- Suter, 1898: 269.
Cantharidus pruinius [sic].- Suter, 1904: 82.
Cantharidus pruninus perobtusus.- Suter, 1913: 125, pl. 39, fig. 6
Photinula coruscans Hedley, 1916: 340, pl. 5, fig. 60. 61. New synonym.
Cantharidus (Plumbelenchus) capillaceus.- Finlay, 1926: 356, 370; Powell, 1955: 53; Dell, 1964: 279, fig. 7; Cernohorsky, 1977: 91, figs. 7, 8.
Cantharidus (Plumbelenchus) coruscans.- Finlay, 1926: 356, 370; Tomlin, 1948: 225; Powell, 1955: 52; Powell, 1957: 139; Dell, 1964: 279, fig. 11, 12.
Cantharidus (Plumbelenchus) minor.- Finlay, 1926: 356, 370.
Cantharidus (Plumbelenchus) pruinosus [sic].- Wenz, 1938: 303, fig. 669.
Cantharidus (Plumbelenchus) capillaceus capillaceus.- Powell, 1979: 55, pl. 18, fig. 4.
Cantharidus (Plumbelenchus) capillaceus coruscans.- Powell, 1979: 55, pl. 18, fig. 5.

Type data:
Trochus capillaceus: Repository of type material unknown, "Nova Hollandia" = Auckland Islands;
Trochus pruninus: Holotype USNM 5605, Auckland Islands;
Canthiridus zealandicus: Lectotype (here selected, 27.0 x 19.0 mm) BMNH 196849/1 (Cernohorsky, 1977, fig. 7, 8) and 2 paralectotypes BMNH 196849/2-3, "New Zealand";
Trochus episcopus: Syntype, and apparently the figured specimen, MNHN, îles Auckland;
Cantharidus pruininus perobtusa: Holotype Academy of Natural Sciences, Philadelphia 40560, no locality data, either Auckland Islands or Antipodes Islands (see below);
Cantharidus pruninus minor: Lectotype (here selected, 8.10 x 6.60 mm) BMNH 1902.5.16.85, and 4 paralectotypes BMNH 1902.5.16.86-89, Auckland Islands, 18 m;
Photinula coruscans: Lectotype (apparently the figured shell and separated head/foot, here selected, 23.0 x 22.8 mm) AMS C.308983 and 10 paralectotypes AMS C.46643, C.46719, north end of Macquarie Island.

Other material examined: Several hundred specimens in 50 lots from throughout the geographic range (NMNZ), and several lots NZOI.



Figures 42-50.
Shells of *Micrelenchus* species. **42,48.** *M. capillaceus* (Philippi). **42.** Holotype of *Cantharidus pruininus perobtusa* Pilsbry, Academy of Natural Sciences, Philadelphia 40560 (21.60 x 19.00 mm). **48.** Protoconch, Auckland Islands, 20 m, NZOI D65. **43,45,49.** *M. dilatatus* (Sowerby). **43.** Holotype, Australian Museum, Sydney C.11505 (10.50 x 9.50 mm). **45.** Detail of teleoconch sculpture, Takapuna, Auckland, M.17173. **49.** Protoconch, Takapuna, Auckland, M.17173. **44,46,47,50.** *M. festivus* n. sp. **44,47.** N of Cape Reinga, 88 m, holotype, M.127084 (4.25 x 3.80 mm). **46.** Between Great Island and Farmer Rocks, Three Kings Islands, 33 m, paratype M.93949 (4.25 x 3.80 mm). **50.** Protoconch, off Three Kings Islands, 88 m, paratype, M.35914. Scale 45, 47 = 1 mm, 48 = 170 μm, 49, 50 = 330 μm.

Distribution: (Fig. 41). Macquarie, Auckland, Campbell and Antipodes Islands, southern New Zealand, 0 - 103 m, living on algae at low tide to 20 m. Formerly living at The Snares, probably during the last glacial maximum (see below).

Remarks: Dell (1964) showed that specimens from the Auckland Islands (height/diameter ratio 1.30-1.39, mean 1.34, SD 0.036, n = 8) and Campbell Island have considerably higher spires than specimens from Macquarie Island (0.90-1.06, mean 0.96, SD 0.044, n = 22) (Figs 34-37, cf. 39). Further data based on

larger samples were supplied by Cernohorsky (1977) (diameter as a percentage of height here converted to height/diameter ratio): Auckland Islands (mean height/diameter ratio 1.32, n = 106), Campbell Island (1.26, n = 68). Most specimens from the Antipodes Islands resemble Macquarie Island shells (Figs 38, 39), though as indicated by Dell (1964, p. 279) the spire height is more variable and intermediate between that of shells from Macquarie Island and the Auckland Islands (0.91-1.26, mean 1.08, SD 0.081, n = 17) (mean 1.07, n = 24 from Cernohorsky, 1977). All other specimens seen from these islands are accordant with the published data with the exception of a beach shell obtained during January 1993 by M.S. Morley at Derry Castle Reef, Enderby Island, Auckland Islands (Fig. 37). This has a height/diameter ratio of 1.22 (21.0 x 17.2 mm) and falls within the range of specimens from the Antipodes Islands. The holotype of *Cantharidus pruininus perobtusa* Pilsbry, 1889 (Fig. 42) has a height/diameter ratio of 1.14 (21.6 x 19.0 mm) and thus resembles shells from the Antipodes Islands, but in the light of Morley's specimen it is unclear whether it came from the Antipodes Islands or the Auckland Islands. As implied by Dell (1964), it would seem that eggs or larvae are transported from Macquarie Island to the Antipodes Islands by the Antarctic Circumpolar Current, which bypasses to the south of geographically intermediate Campbell Island (Fig. 41). The intermediate morphology of Antipodes Islands shells is presumably due to influx of genes via eggs or larvae from the downstream Campbell Island population as well. Although *M. capillaceus* is known to be a broadcast spawner (Simpson, 1977), the duration of the interval between fertilisation of the egg and settlement is unknown. Unable to detect any other differences between high and low-spired specimens, I conclude that they represent extreme forms of a single polymorphic species, the earliest name for which is *Trochus capillaceus* Philippi, 1848. The ecology of this species has been discussed by Simpson (1976).

Two small, old-looking juvenile shells (width 2.95 mm and fragment of larger shell) were obtained at NZOI station D139, south of The Snares at 150 m (48°20.5'S, 167°46.5'E) from a substratum of rocks, bryozoans and shell. Also present in the sample, and in similar condition, were two specimens of a form of *M. mortenseni* with banded rather than spotted spiral cords as in fresh specimens from the area (see below). These presumably date from the last glacial maximum, and lived at The Snares when the sea was cooler and at a lower level.

None of the syntypes of *Photinula coruscans* are exactly accordant with Hedley's given dimensions ("height 21 mm, major diameter 23 mm" - in text, no dimensions or scale in figure legend), and the shell and separated head/foot chosen as lectotype are considered to be those originally figured as "shell and animal (from alcoholic specimen) ...Type specimen".

Micrelenchus (Plumbelenchus) dilatatus (Sowerby, 1870)
(Figs 43, 45, 49, 51)

Elenchus dilatatus Sowerby, 1870: 251; Hutton, 1873: 39; Hutton, 1880: 101.
Chrysostoma simulata Hutton, 1873: 36.
Gibbula simulata.- Hutton, 1880: 102.

Cantharidus dilatatus.- Hutton, 1884: 363; Suter, 1897: 272, text fig.; Suter 1913: 123, pl. 33, fig. 5.
Cantharidus simulatus.- Hutton, 1884: 363.
Photinula suteri Smith, 1894: 58, pl. 7, fig. 3.
Gibbula suteri.- Suter, 1897: 278, text fig.; Suter, 1913: 138, pl. 33, fig. 10
Micrelenchus dilatatus.- Finlay, 1926: 355, 370; Habe, 1959: 37, text fig. 4; Powell, 1979: 56, pl. 18, fig. 6; Hickman and McLean, 1990: fig. 61i.

Type data:
Elenchus dilatatus: Holotype Australian Museum, Sydney C.11505 "New Zealand", type locality here designated as Russell, Bay of Islands (see below);
Chrysostoma simulata: Syntypes (2) NMNZ M.208, Chatham Islands;
Photinula suteri: Syntypes (18) BMNH 1893.5.27.24-26 (3), BMNH 1893.5.27.27-41 (15), Academy of Natural Sciences, Philadelphia 73817 (21), Lyttelton Harbour, H. Suter.

Other material examined: >1000 specimens in 85 lots NMNZ.

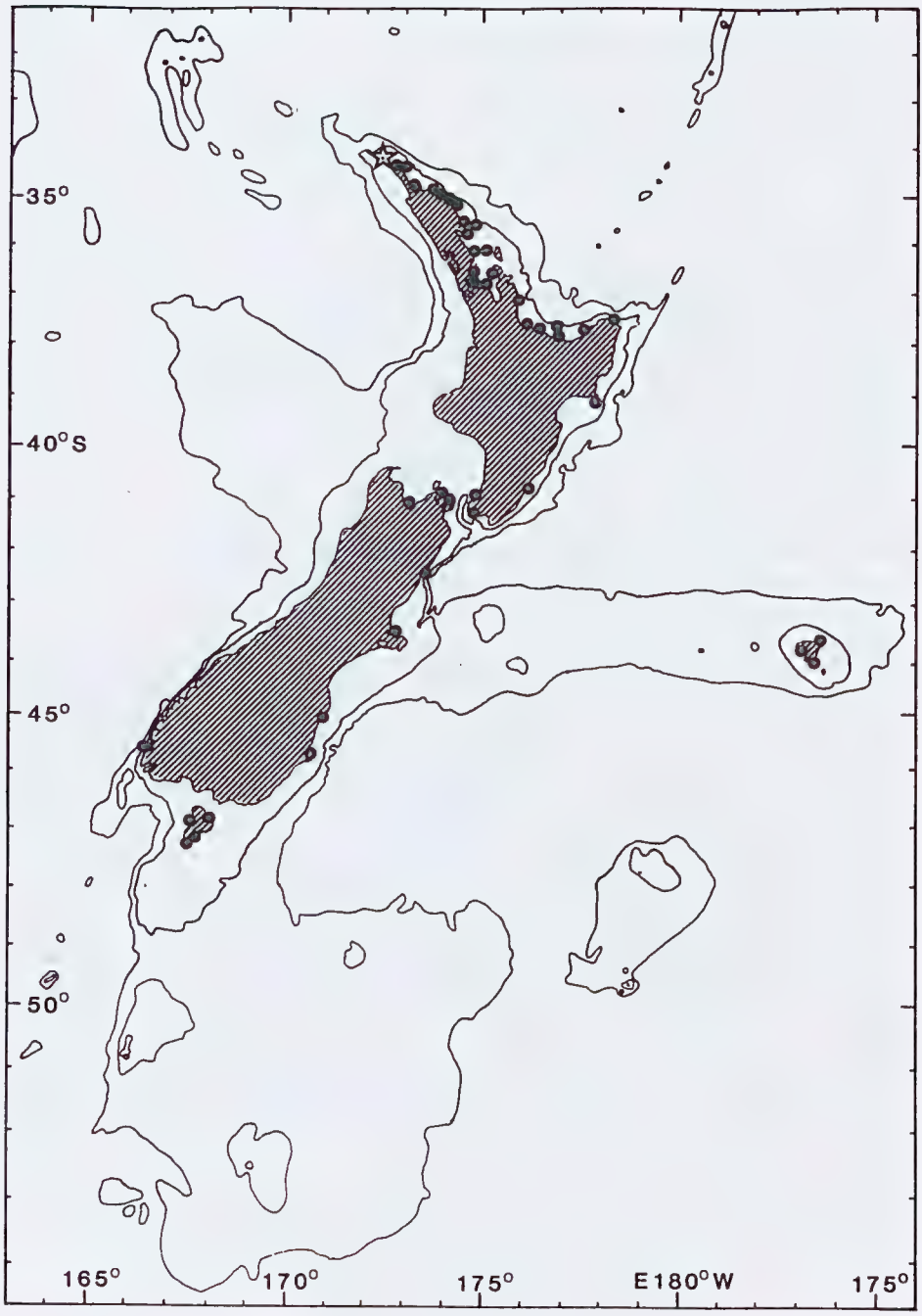
Distribution: (Fig. 51). North, South, Stewart and Chatham Islands, New Zealand, 0 - 73 m, living on algae intertidally to about 5 m.

Remarks: Micrelenchus dilatatus is characterised by the combination of a sculpture of numerous fine spiral grooves, and a large, flared, D-shaped aperture. Colour and colour pattern are exceedingly variable. It is the most widely distributed *Micrelenchus* species, and is common around North, South and Chatham islands. It has not been recorded from south of Stewart Island, and does not occur north of Cape Reinga, where a closely related species occurs at greater depths (see below). There is considerable variation in the size at which the species attains maturity both within populations and from population to population, shells with fully developed apertural features ranging from 3.40 to 11.50 mm in height. Specimens that attain maturity at small size tend to be more broadly conical than larger adults because the spire angle decreases with increasing shell size (cyrtoconoid) before expansion of the last part of the last whorl. All mature specimens seen from the South Island are small (height 3.40-6.70 mm), the smallest adults occurring in Dusky Sound, Fiordland (NMNZ M.94514). Specimens from the North Island, Stewart Island and the Chatham Islands attain large size.

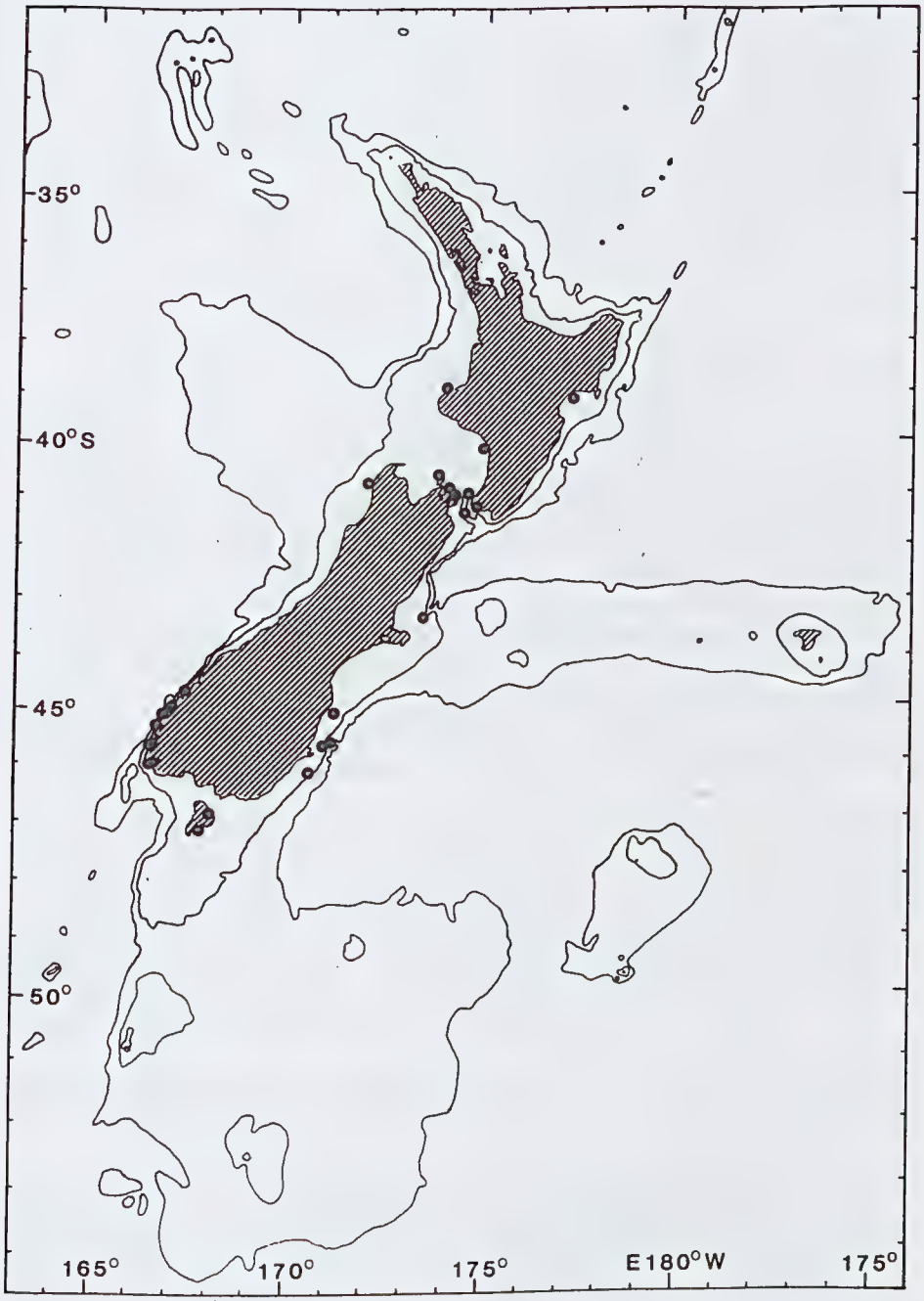
The holotype of *Elenchus dilatatus* (Fig. 43) is perfectly accordant with specimens from Russell, Bay of Islands (NMNZ), which is thus designated type locality. *Photinula suteri* is based on small adults and juveniles of *M. dilatatus*.

Micrelenchus (Plumbelenchus) festivus n. sp.
(Figs 44, 46, 47, 50, 51)

Description: Shell up to 6.20 mm high, higher than wide, anomphalous; spire narrowly conical, weakly cyrtoconoid, 0.90-1.09x higher than aperture, at maturity last quarter whorl expanding more rapidly and apertural profile more



Figures 51.
Maps of New Zealand region showing distributions of *Micrelenchus* species: 200 and 1000 m contours indicated. **51.** *M. dilatatus* (Sowerby)(●) and *M. festivus* n. sp. (★).



Figures 52.
Maps of New Zealand region showing distributions of *Micrelenchus* species: 200 and 1000 m contours indicated. **52.** *M. artizona* (A. Adams).

strongly tangential than before. Colour and colour pattern extremely variable, spotted, streaked and axially banded in various combinations of shades of pink, red, yellow, orange, or brown, some specimens with a greenish flush or predominantly white. Axial bands prosocline, shape, size and number variable, area occupied varying from narrow subsutural band to whole shell. Nacreous layer brilliantly iridescent. Protoconch 270 μm wide, sharply delineated, smooth, apical fold tip tapered. Teleoconch of up to 4.25 broadly convex whorls; last adult whorl more broadly convex than before, last quarter whorl more rapidly expanding and more strongly convex. Sculptured with numerous fine, crowded spiral threads that are variable in size and number and that multiply by fission, 20 - 30 on adult penultimate whorl, 15 - 20 on base. Adult aperture large; peristome D-shaped, continuous, thickened.

Type data: Holotype NMNZ M.127084 (4.25 x 3.80 mm: 3.8 teleoconch whorls) and 15 paratypes M.35914: 34°21'S, 172°37E, NW of Cape Reinga, alive, 88 m, 19 February 1974, r.v. Acheron. Paratypes (84 NMNZ): Tasman Bay, Great Island, Three Kings Islands, alive, sublittoral algae washings, A.N. Baker, 19 February 1974 (3, M.21184); Elingamite wreck, off West Island, Three Kings Islands, 37 m, 16 March 1981, airlifted K. Tarlton (13, M.127175); off N face of Hinemoa Island, Three Kings Islands, dead, 23 m, 11 February 1986, scuba G.S. Hardy (50, M.112538); off Hinemoa Island, dead, 15 m, 17 January 1985, scuba F.J. Brook (1, M.109278); off Princes Rocks, Three Kings Islands, dead, 15 m, 2 December 1983, scuba G.S. Hardy and A.L. Stewart (1, M.127174); off Princes Rocks, dead, 14 m, 4 January 1976, scuba A. Watson (3, M.49801); between Great Island and Farmer Rocks, dead, 53 m, 17 February 1983, scuba G.S. Hardy (8); off Southwest Rocks, Three Kings Islands, dead, 33 m, 3 January 1976, scuba A. Watson (5, M.54018).

Other material examined: 34°09.1'S, 172°08.4'E, Northwest Bay, Great Island, Three Kings Islands, alive, airlifted from low mixed algae on boulders (mostly coralline), 23 m, 3 March 1997, K. Burch and D. Crosby (30, M.134666); 34°09.5'S, 172°08.8'E, Southeast Bay, Great Island, 20-22 m, airlifted from low mixed algae on boulders (mostly coralline), 4 March 1997, K. Burch and D. Crosby (many, M.134681); 34°09.5'S, 172°08.8'E, Southeast Bay, Great Island, airlifted from under boulders, 13-15 m, 5 March 1997, K. Burch and D. Crosby (25, M.134853).

Distribution: (Fig. 51). Off Three Kings Islands and off Cape Reinga, northern New Zealand, 13-88 m, taken alive with algae at 20-88 m. Restricted endemic.

Remarks: Compared with *Micrelenchus dilatatus*, which it closely resembles in shape, *M. festivus* differs principally in attaining smaller size (specimens with mature shell facies 3.75-6.20 mm versus 3.40-11.50 mm), in having weaker teleoconch sculpture, and in that the protoconch in most specimens is smaller (width 285-300 μm, mean 288 μm, n = 10, as against 285-330 μm, mean 311 μm, n = 10). Adults of *M. dilatatus* within its shell size range are more broadly conical, although large adults of both species have the same shell shape.

Despite its similarity to *M. dilatatus*, which lives intertidally only about 10km south-east of the type locality, *M. festivus* is considered to be a distinct

allopatric species that has evolved from a common ancestor isolated (perhaps originally at the Three Kings Islands) by strong tidal flow and bathymetry northwest of Cape Reinga. This is suggested by its greater habit depth (20-88 m, versus intertidally to 5 m for *M. dilatatus*) in an area where sea temperature is cool and salinity is reduced due to upwelling, and in which there is pronounced regional endemism (see remarks on *Cantharidus burchorum* n. sp.). Given their close proximity, *C. festivus* and *C. dilatatus* may well prove to have overlapping distributions on rocky shores between Cape Reinga and North Cape, but collections from appropriate depths (20-88 m) there are currently inadequate.

Etymology: Delightful (Latin).

Micrelenchus (Plumbelenchus) artizona (A. Adams, 1853)
(Figs 52-57, 61)

Canthiridus [sic] *artizona* A. Adams, 1853: 170.
Canthiridus [sic] *rufozona* A. Adams, 1853: 170 (in part).
Cantharidus sanguineus var. *elongata* Suter, 1897: 272. New synonym.
Cantharidus sanguineus elongatus.- Suter, 1913: 128, pl. 38, fig. 14.
Gibbula micans Suter, 1897: 279, text fig.; Suter, 1913: 137, pl. 33, fig. 9. New synonym.
Cantharidus rufozona.- Smith, 1915: pl. 1, fig. 19 only (not A. Adams, 1853).
Micrelenchus sanguineus elongatus.- Finlay, 1926: 370.
Micrelenchus micans.- Finlay, 1926: 370; Fleming, 1948: 85, pl. 7, fig. 16; Fleming, 1950: 26; Boreham, 1959: 26; Powell, 1979: 56.
Micrelenchus sanguineus bakeri Fleming, 1948: 85, pl. 7, fig. 12; Fleming, 1950: 26. New synonym.
Micrelenchus sanguineus sanguineus.- Fleming, 1948: 85, pl. 7, fig. 13 (not Gray, 1843).
Micrelenchus caelatus bakeri.- Fleming, 1951: 137; Boreham, 1959: 26; Powell, 1979: 56.
Micrelenchus caelatus elongatus.- Fleming, 1951: 137; Boreham, 1959: 26; Powell, 1979: 56, pl. 18, fig. 11.
Micrelenchus rufozonus.- Dell, 1963: 175, fig. 14 (not A. Adams, 1853).

Description: Shell up to 9.50 mm high, weakly cyrtoconoid, anomphalous, spire height variable within populations (height/diameter ratio 1.10-1.37). Colour and colour pattern extremely variable within populations, though one combination of characteristics may predominate in some populations. Protoconch and first 1-2 teleoconch whorls typically yellow, pink in some specimens. Subsequent whorls shades of red, pink, greenish brown, grey or black, typically on a paler ground, either as continuous bands, alternate spots, or a variable combination on spiral cords. Some specimens irregularly mottled or axially maculated with shades of greenish brown on a paler or white ground, others with maculations and/or paler or darker spots in variable combinations with pigmented spiral cords. Protoconch 230 μm wide, smooth, tip narrowly pinched. Teleoconch whorls weakly to rather strongly convex, sculptured with

smooth spiral cords; periphery evenly rounded to angulate, typically with a prominent peripheral bulge surmounted by peripheral spiral and adjacent spire spiral. Spiral cords glossy, multiplying by intercalation in majority of specimens, by fission in others; about as high as wide, smooth, narrow and closely spaced, typically numbering 9-15 on adult penultimate whorl (including peripheral spiral, which is more or less covered by last whorl), occasional specimens with as few as 7 or 8; 8-13 on base. Spiral interspaces not glossy, with very fine, crowded axial lamellae on last whorl. Aperture roundly subquadrate, simple, a prominent bulge on columella.

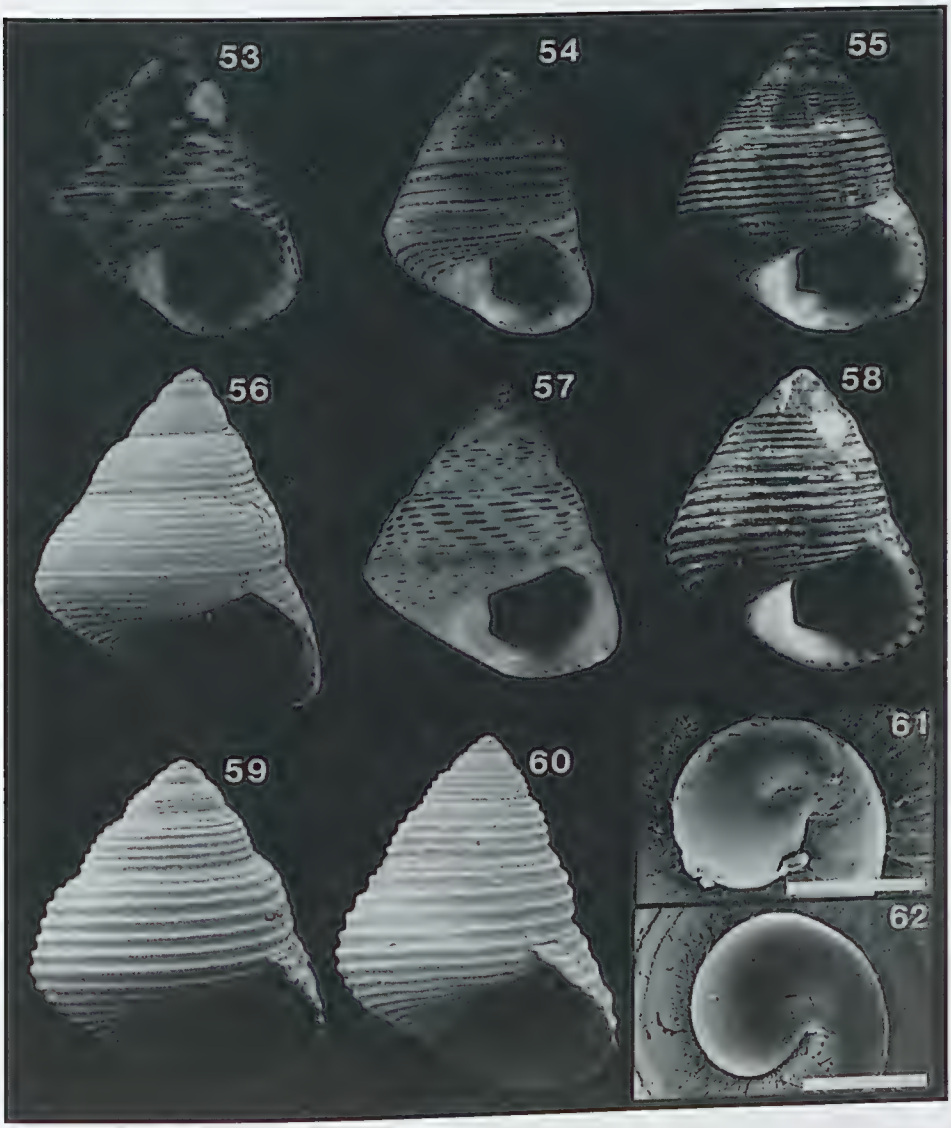
Type data:
Canthiridus artizona: Lectotype (here selected, 9.30 x 6.70 mm, fig. 54) BMNH 196852/1 and 4 paralectotypes BMNH 196852/2-5, described from unknown locality, type locality here designated as Tasman Bay, New Zealand;
Cantharidus sanguineus elongatus: Lectotype (Fleming, 1951) NZGS TM447 and 2 paralectotypes NZGS TM448 and NMNZ M.69356, Lyall Bay, Wellington;
Gibbula micans: Lectotype (Boreham, 1959) NZGS TM451 and paralectotype TM452, near Resolution Island, Dusky Sound;
Micrelenchus sanguineus bakeri: Holotype NZGS TM439, Northport, 0.4 km NE of anchorage, Chalky Sound, 7-15 m.

Other material examined: > 500 specimens in 81 lots NMNZ.

Distribution: (Fig. 52) Southern half of North Island, South Island and Stewart Island, New Zealand, 0-585 m, living at 15-446 m on bryozoan/shell substrata, once taken alive at low tide (Chalky Inlet, Fiordland, M.132047).

Remarks: Comparison of the type specimens revealed that *Canthiridus artizona* A. Adams, 1853 (lectotype Fig. 54) is the earliest name for *Cantharidus sanguineus* var. *elongata* Suter, 1897, *Gibbula micans* Suter, 1897, and *Micrelenchus sanguineus bakeri* Fleming, 1948. The syntypes of *Canthiridus artizona* closely resemble shells from Tasman Bay beaches (e.g. Nelson, NMNZ M.87286), which suggests that they were obtained offshore (alive) there, probably by Frederick Strange during the survey by H.M.S. Acheron.

Some specimens from the Cook Strait area and Stewart Island have as few as seven or eight spire spirals (typically 9-15), though there is complete gradation to specimens with more numerous spiral cords within samples. Specimens from within the fiords of Fiordland are distinctive in being consistently smaller at maturity than specimens from the fiord entrances and elsewhere (maximum height 7.00 mm as against 9.50 mm), thin, and are predominantly rather uniform grey, or grey and spotted or banded in paler shades or white. These include the type material of *Gibbula micans* and the specimen illustrated as *M. micans* by Fleming (1948, pl. 7, fig. 16). More typical specimens, including the type material of *M. sanguineus bakeri*, occur at or nearer the fiord entrances. Unable to convince myself that more than a single highly variable species is involved, I interpret specimens from the inner fiords as ecophenotypic variants induced by the unusual local hydrological conditions there (Grange et al., 1981). The type material of *M. sanguineus bakeri* is indistinguishable from specimens of *M.*



Figures 53-62.
Shells of *Micrelenchus* species. 53-57,61. *M. artizona* (A. Adams). **53.** Halfmoon Bay, Port Pegasus, Stewart Island, 15 m, M.70981 (6.50 x 5.75 mm). **54.** Lectotype, BMNH 196852/1 (9.30 x 6.70 mm). **55.** Paralectotype of *M. rufozona*, BMNH 196853/3 (6.65 x 5.40 mm). **56.** Paterson Inlet, Stewart Island, M.19800 (6.20 x 5.10 mm). **57.** Off Karori Rock, Cook Strait, 256-274m, M.55032 (6.25 x 5.50 mm). **61.** Protoconch, off Voila Voe, Paterson Inlet, Stewart Island, 15-18 m, M.19604. 58-60,62. *M. rufozona*. **58.** Lectotype, BMNH 196853/1 (6.05 x 5.15 mm). **59.** Off Waitotara River mouth, 33-35 m, M.50434 (4.90 x 4.20 mm). **60.** Off Matata, 29m, M.61215 (7.35 x 5.70 mm). **62.** Protoconch, off Waitotara River mouth, 33-35 m, M.50434. Scale = 170 μm.

artizona from the Cook Strait area. Fleming (1950) listed *M. micans* and *M. sanguineus bakeri* as occurring together in New Golden Hind Expedition stations 36 and 80. All specimens from station 36 (entrance to Northport) are the *bakeri* form. The specimens from station 80 cannot be traced (A.G. Beu, pers. comm.).

Despite being one of the most common sublittoral *Micrelenchus* species off southern New Zealand, *M. artizona* and its synonyms have been poorly known and have seldom, if at all, been correctly identified in collections, primarily due to confusion with the superficially similar species *M. caelatus* and *M. rufozona*. *M. artizona* occurs sympatrically with *M. rufozona* off the southern North Island and northern South Island, and with *M. caelatus* off east Otago (see below).

One of the two paralectotypes of *C. rufozona* (BMNH 196853/3) (Smith, 1915, pl. 1, fig. 19; Dell, 1963, fig. 14) is a fresh, live-taken specimen of *M. artizona* (Fig. 55). It is perfectly accordant with specimens from Stewart Island from 15-18 m depth, and was perhaps obtained there during the 1849-50 survey by H.M.S. Acheron, and sent to Cuming by Frederick Strange.

Micrelenchus (Plumbelenchus) rufozona (A. Adams, 1853)
(Figs 58-60, 62, 63, 65)

Canthiridus [sic] *rufozona* A. Adams, 1853: 170 (in part = *M. artizona*).
Cantharidus rufozona.- Hutton, 1880: 101; Suter, 1897: 273, text fig.; Suter, 1913: 127, pl. 39, fig. 21.
Cantharidus rufozonas [sic].- Suter, 1904: 82.
Cantharidus rufozona.- Smith, 1915: 79 (text only, figured specimen = *M. artizona*)
Micrelenchus rufozonus.- Finlay, 1926: 370; Powell, 1937: 63, pl. 8, fig. 4; Powell, 1979: 56, pl. 18, fig. 15.
NOT *Cantharidus rufozona*.- Hutton, 1884: 362 = *Thalotia conica* (Gray, 1827).
NOT *Cantharidus rufozona*.- Smith, 1915, pl. 1, fig. 19 = *M. artizona*.
NOT *Micrelenchus rufozonus*.- Dell, 1963: 175, pl. 2, fig. 14 = *M. artizona*.

Type data:
Canthiridus rufozona: Lectotype (here selected, 6.05 x 5.15 mm, Fig. 58) BMNH 196853/1, and 2 paralectotypes BMNH 196853/2-3, ex H. Cuming, described from unknown locality, type locality here selected as off south-western North Island (see below). BMNH paralectotype 196853/3 is a specimen of *M. artizona* (A. Adams, 1853) (see above).

Other material examined: About 1000 specimens in 69 lots NMNZ.

Distribution: (Fig. 63) Off Three Kings Islands, 100-550 m (old worn shells only). North-eastern and south-western North Island, and off D'Urville, northern South Island, New Zealand, 0-94 m, living at 4-64 m on clean sand and shell substrata with low algae.

Remarks: M. rufozona is variable in size at maturity (height 4.20-8.80 mm), number and thickness of the spiral cords, and colour and colour pattern. The spire ranges from narrowly to broadly conical (height/diameter ratio 1.08-1.37),

and the spire whorls may be strongly or weakly convex. The spiral cords may be smooth throughout or very finely beaded on the early whorls. Uninjured specimens have five to seven similar primary spiral cords on the spire before the last adult whorl (where secondary spirals may arise by intercalation), this number includes the abapical (peripheral) spiral, which is more or less covered by succeeding whorls but that frequently becomes fully exposed at the end of the penultimate whorl in adults. Most specimens have an additional, weaker subsutural spiral cord. Where present the sixth and seventh spirals typically arise by intercalation between the subsutural spiral and the adjacent primary spiral, and between the two adapical primaries. Specimens from the north-eastern North Island typically have five primary spiral cords before the last adult whorl, occasionally six through early intercalation of a secondary. All specimens from off the south-western North Island have six or seven primary spiral cords before the last adult whorl, and approach high-spired Chatham Island forms of *M. mortenseni* (see below). The spiral cords on all but the first few whorls are typically uniform deep red or pink, with paler or white interspaces (Fig. 59). Some specimens from the north-eastern North Island, however, may be spirally or axially banded in shades of greenish brown or grey on a predominantly white ground, and others may have some or all cords spotted in paler or darker shades.

Forms from the north-eastern and south-western North Island are interpreted as disjunct local populations of a single species that formerly had a continuous distribution, probably prior to the last glacial maximum.

M. rufozona most closely resembles *M. artizona*, differing in having five to seven spiral cords on the penultimate whorl instead of seven to fifteen (typically 9-15, counts include peripheral spiral), in lacking a peripheral bulge (typically present in *M. artizona*), and in having higher spiral cords with correspondingly deeper interspaces. Although some specimens of *M. artizona* resemble *M. rufozona* in the number of spiral cords and periphery shape, most specimens from within or very near to the zone of geographical overlap have more numerous spirals and the peripheral bulge. The exception is a sample from Tahunanui Beach, Nelson (M.87286), a small proportion of which resemble *M. rufozona* in shape and number of spiral cords, though the spiral cords are accordantly weaker. The distributions *M. artizona* and *M. rufozona* overlap in respectively the northern and southern parts of their ranges, and they have been taken alive together (i.e. sympatrically) at 62 m depth off the western side of D'Urville Island, northernmost South Island (M.50386, M.120147).

Micrelenchus rufozona is common in carbonate sediments off the Three Kings Islands, although all specimens seen are worn, and it probably lived there when the sea level was lower than at present (Nelson et al., 1982; Nelson and Hancock, 1984).

The specimen mentioned and illustrated by Dell (1963, p. 175, fig. 14) (Fig. 55) as "the type" and "type" of *M. rufozona* is one of three syntypes that is in fact conspecific with *Micrelenchus artizona* (A. Adams, 1853). The same specimen was illustrated by Smith (1915), though its type status was not indicated. The two other syntypes are *M. rufozona* as normally interpreted (e.g. Suter, 1897, 1913; Powell, 1937, 1946a, 1957, 1962, 1976, 1979; herein). On the face of it, by

application of ICZN article 74, it might seem that Dell inadvertently designated a lectotype, thereby rendering *M. rufozona* a synonym of *M. artizona* and leaving the common species long and well known as *M. rufozona* (of authors, not A. Adams) without a name. However, R.K. Dell has informed me (pers. comm.) that he had no intention of designating lectotypes in his 1963 paper, and that each specimen indicated as "type" in the legends was a type specimen in a loose sense. Moreover, no other indications of "type" or "the type" with respect to specimens of other species mentioned or illustrated as in this paper have been interpreted as lectotype designations by subsequent authors. According to Dell's original notebook (NMNZ) and as confirmed by K.M. Way (pers. comm.), the lot studied by Dell comprised three specimens as it does now. To avoid having to rename *M. rufozona* of authors, I have chosen one of the previously unillustrated syntypes as the lectotype (Fig. 58).

The lectotype and conspecific paralectotype were collected dead and are perfectly accordant in morphology and condition with specimens taken at 33-40 m depth off Patea, south-western North Island (Fig. 59). They certainly could not have originated from a north-eastern North Island population. These were presumably obtained by the naturalist Frederick Strange while aboard H.M.S. Acheron (Natusch, 1978) during the 1849 survey of the area off Patea, either by dredging or from tallow on the sounding weight.

Hutton's (1884) record of *Cantharidus rufozona* is based on mislocalised specimens of *Thalotia conica* (Gray, 1825) (recorded as such by Suter, 1897, 1913), which is endemic to southern Australia - specimen illustrated by Suter (1913, pl. 39, fig. 8) NMNZ M.536.

The specific epithet is derived from the Latin *zona* (belt), a feminine first declension nominative, so the termination must be "a" rather than "us" as it has been since the species was referred to *Micrelenchus*.

Micrelenchus (Plumbelenchus) caelatus (Hutton, 1884)
(Figs 63, 66-68)

Cantharidus sanguineus var. *caelatus* Hutton, 1884: 363.
Cantharidus sanguineus var. *caelata*.- Suter, 1897: 272, text fig. (in part = *M. mortenseni*).
Cantharidus sanguineus caelatus.- Suter, 1913: 128. (in part = *M. mortenseni*)
Cantharidus sanguineus.- Suter, 1913: pl. 33, fig. 8 (only).
Micrelenchus sanguineus coelatus [sic].- Finlay, 1926: 355, 370.
Micrelenchus sanguineus caelatus.- Powell, 1937: 63.
Cantharidus (Micrelenchus) sanguineus.- Wenz, 1938: 303, fig. 670 (not Gray, 1843).
Micrelenchus caelatus caelatus.- Fleming, 1951: 137; Powell, 1955: 54; Powell, 1979: 55, pl. 18, fig. 10.
NOT *Micrelenchus caelatus caelatus*.- Powell, 1955: 54 (= *M. mortenseni*).

Figures 63, 64.
Maps of New Zealand region showing distributions of *Micrelenchus* species: 200 and 1000 m contours indicated. **63.** *M. rufozona* (A. Adams) (●) and *M. caelatus* (Hutton) (▲). **64.** *M. mortenseni* (Odhner).

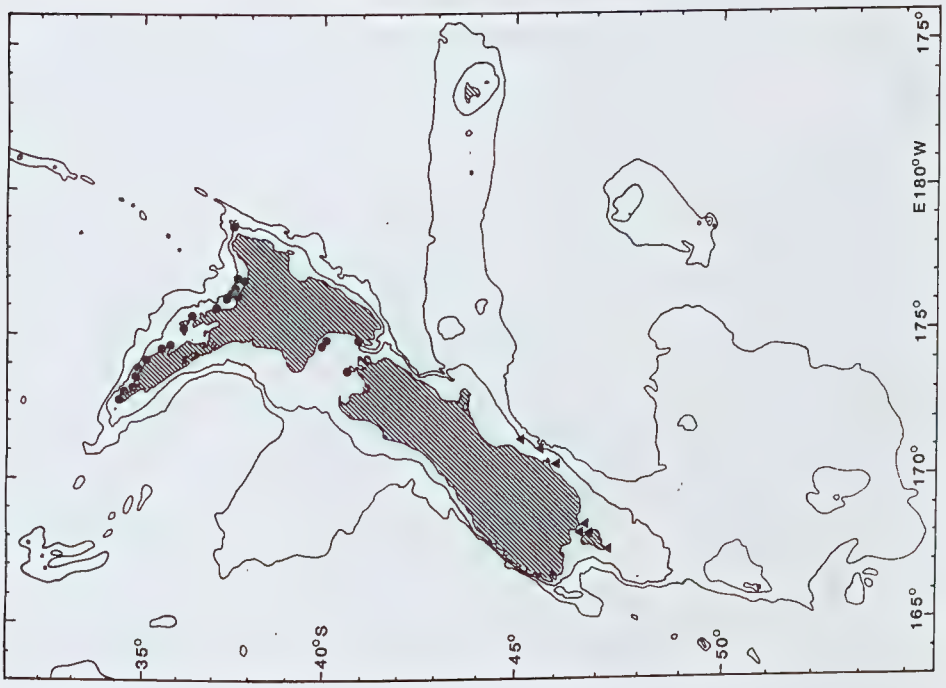


Figure 63

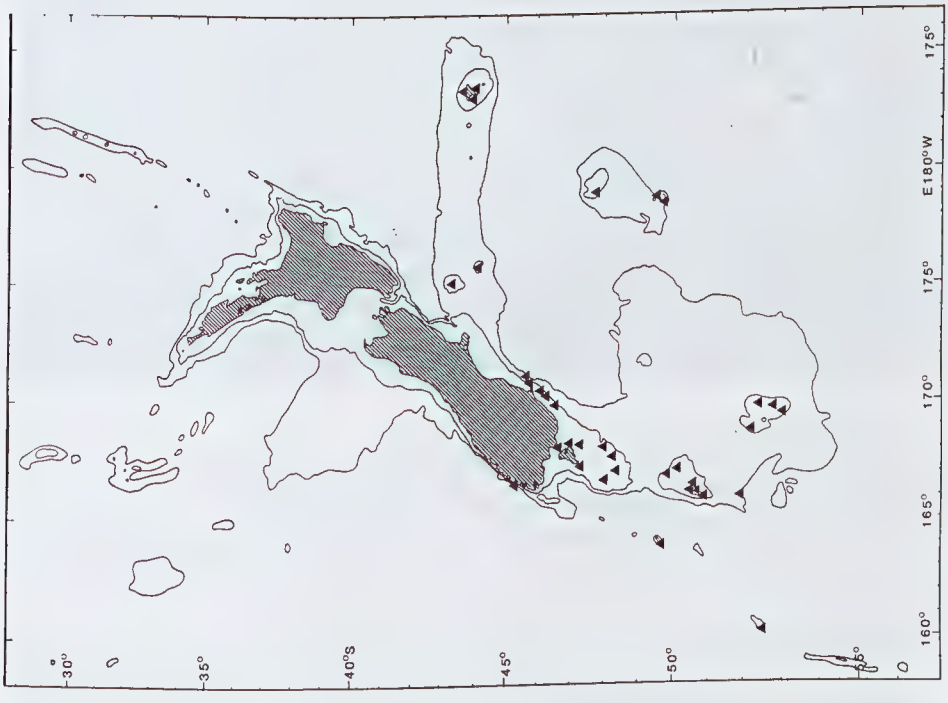


Figure 64

Type data: Lectotype (here selected: 4.60 x 4.10 mm) CM M.9927 and 2 paralectotypes (the larger = *M. mortenseni*) CM M.9928, Foveaux Strait.

Other material examined: Several hundred specimens in 24 lots NMNZ.

Distribution: (Fig. 63) Off East Otago and Stewart Island, New Zealand, 15-420 m, living at 15-200 m on bryozoan/sand/shell substrata.

Remarks: Micrelenchus caelatus most closely resembles *M. rufozona*, from which it differs principally in having considerably narrower spiral interspaces. Unlike *M. rufozona*, most specimens of which have the spiral cords on the spire and base uniformly pigmented, *M. caelatus* typically has the spiral cords on the last one or two whorls alternately spotted with pink and white, though occasional specimens have uniform pink spires and spotted bases. The two species are allopatric (Fig. 63). Compared with *M. artizona*, with which occurs sympatrically off East Otago (e.g. M.112294, 112308), *M. caelatus* differs principally in having much stronger spiral cords and, where their ranges overlap, a considerably thicker outer lip at maturity. *M. caelatus* also occurs sympatrically with *M. mortenseni* off East Otago.

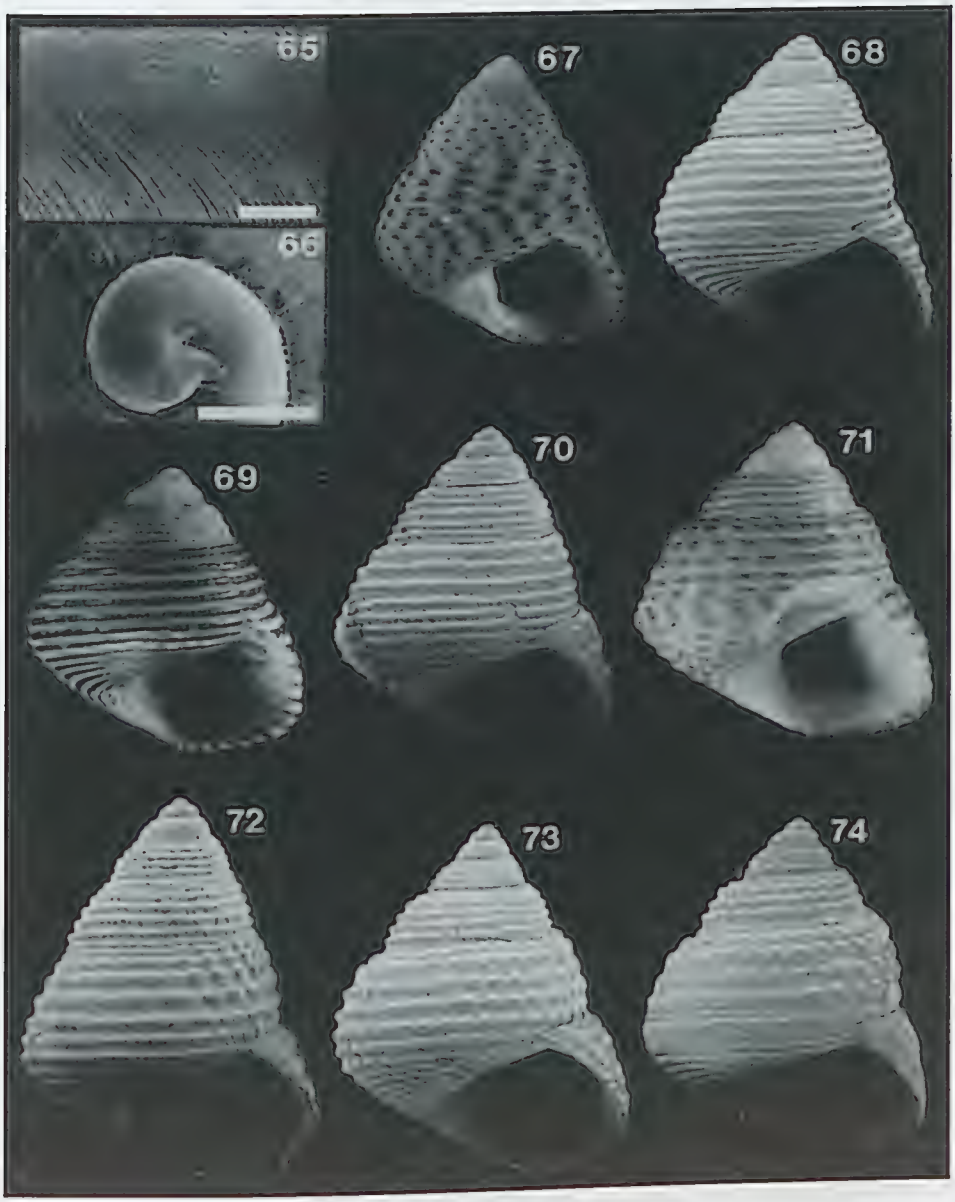
As noted above, the specimen illustrated by Suter (1897, 1913 - the latter illustration is a poor engraver's rendition of the former) as "*Cantharidus sanguineus*" clearly represents *M. caelatus*, and was probably from Suter collection lot 1301 (NZGS, 5.50 x 4.70 mm).

Suter's (1913) record of this species from "Whangaroa Harbour (C. Traill)" is based on mislocalised Stewart Island material.

Micrelenchus (Plumbelenchus) mortenseni (Odhner, 1924)
(Figs 64, 69-81)

Cantharidus sanguineus.- Suter, 1897: 271 (in part).
Cantharidus sanguineus caelatus.- Suter, 1913: 128 (in part)
Gibbula mortenseni Odhner, 1924: 14, pl. 1, fig. 3.
Micrelenchus sanguineus mortenseni.- Finlay, 1926: 355.
Micrelenchus sanguineus.- Finlay, 1928: 238. Not Gray, 1843.
Micrelenchus sanguineus morioria Powell, 1933: 194, pl. 36, figs 10, 11. New synonym.
Micrelenchus caelatus mortenseni.- Fleming, 1951: 137; Powell, 1955: 54; Powell, 1979: 56.
Micrelenchus caelatus morioria.- Fleming, 1951: 137; Powell, 1979: 56.
Micrelenchus caelatus caelatus.- Powell, 1955: 54 (not Hutton, 1884).
Micrelenchus caelatus mortenseni.- Powell, 1955: 54 (in part).
Micrelenchus caelatus archibenthicola Dell, 1956: 45, pl. 6, fig. 56; Powell, 1979: 55. New synonym.

Type data:
Gibbula mortenseni: Lectotype (GAS-203: the originally figured specimen here selected) and 1 subadult paralectotype (GAS-204), Zoological Museum, Copenhagen, Carnley Harbour, Auckland Islands, 82 m.



Figures 65-74.
Shells of *Micrelenchus* species. **65.** *M. rufozona* (A. Adams), detail of teleoconch microsculpture, off Matata, M.61215. **66-68.** *M. caelatus* (Hutton). **66.** Protoconch, off Poutama Island, Big South Cape, Stewart Island, 55 m, M.19802. **67.** Off Otago Heads, 220 m, M.66896 (6.10 x 5.40 mm). **68.** Foveaux Strait oyster beds, 33-35 m, M.70835 (5.15 x 4.50 mm). **69-74.** *M. mortenseni* (Odhner). **69.** Off Owenga, Chatham Islands, 18 m, paratype of *M. morioria* Powell, AIM AK71531 (5.80 x 5.60 mm). **70, 71.** Off The Sisters, Chatham Islands, 70 m, M.12700 (70, 5.65 x 5.00 mm; 71, 5.50 x 5.35 mm). **72.** Mernoo Bank, western Chatham Rise, M.15508 (4.10 x 3.25 mm). **73.** Off Otago Heads, 220 m, M.66897 (5.30 x 4.50 mm). **74.** Between Dea's Head and Tucker Cove, Auckland Island, 26-27 m, M.16755 (6.45 x 5.45 mm). Scale 65 = 100 μm, 66 = 170 μm.

Micrelenchus sanguineus morioria: Holotype AIM AK70471, off Owenga, Chatham Islands, alive, 18 m.
Micrelenchus caelatus archibenthicola: Holotype NMNZ M.9323, 45°45.4'S, 171°05'E, off East Otago, 549 m.

Other material examined: 1000+ specimens (36 lots NMNZ, 55 lots NZOI, 5 lots AIM)

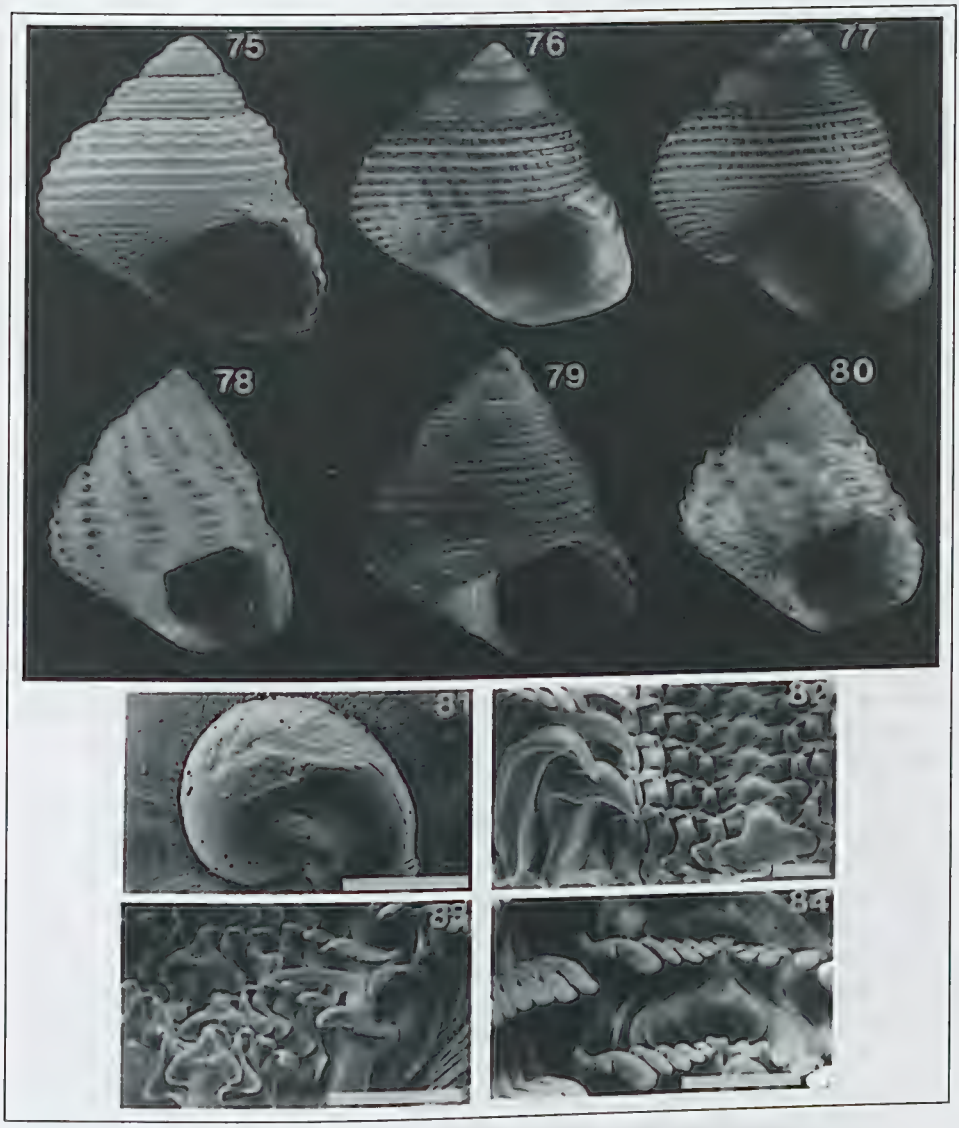
Distribution: (Fig. 64) Mernoo and Veryan banks, western Chatham Rise; East Otago, and Stewart, Chatham, Snares, Auckland, Campbell, Bounty, and Antipodes Islands, and Macquarie Ridge, southern New Zealand, 20-244 m, living at 10-244 m on coarse bryozoan/shell substrata.

Remarks: As here interpreted, *M. mortenseni* is exceptionally variable and widely distributed off southern New Zealand. *M. mortenseni* has long been confused with *M. caelatus*, which occurs within its range off East Otago and Stewart Island. The two species have been dredged together in substantial quantities (sympatrically alive at 200 m, NMNZ M.45443 and M.119173). Compared with specimens of *M. caelatus* from within its geographic range, *M. mortenseni* differs principally in being much more strongly nodular, in that the earliest teleoconch whorls are pink rather than yellow, and in that the interior behind the outer lip of mature specimens is much more strongly thickened and weakly but distinctly channelled beside the insertion. Widely separated local populations of *M. mortenseni* have distinctive combinations of shell morphology, colour and colour pattern. The Chatham Islands form is the most variable, and includes the type material of *M. morioria*, here considered a junior synonym of *M. mortenseni*.

Specimens from East Otago and Stewart, Snares, Campbell and Auckland islands have five or six strong, similar, nodular spiral cords on the spire (including abapical spiral, summit of which is more or less covered by succeeding whorls); and eight or nine similar, weakly nodular cords on the base. The first 2.0-2.5 teleoconch whorls are pink, the later ones are translucent white with pink axial bands, the colour being limited to the spiral cords. Specimens from the Auckland Islands (Fig. 74, 80) and Campbell Island are the most strongly nodular, and specimens from off The Snares (e.g. NZOI stns D139, D144) are sculpturally (and geographically) intermediate between Otago and Auckland Islands shells.

Specimens from Mernoo Bank (Fig. 72), at the extreme north-west of the geographic range, are distinctive in that the early teleoconch whorls are white rather than pink, and in that the later whorls of most specimens are white with brown axial bands, though otherwise identical pink-spotted specimens occur with them. Most Mernoo Bank specimens are also more narrowly conical and finely nodular than any others, though the broader shells are indistinguishable from narrow Otago shells in shape, and some are as strongly nodular. The few specimens available from adjacent Veryan Bank (NZOI stn D1) also have white early teleoconch whorls, but otherwise resemble narrow Otago shells in colour, shape and sculpture.

Most available specimens from the Chatham Islands are worn or broken



Figures 75-84.
Shells (75-81) and radulae (82-84) of *Cantharidus* and *Micrelenchus* species. **75-81.** *M. mortenseni* (Odhner). **75.** Off Bounty Islands, 73 m, M.8521 (4.80 x 4.65 mm). **76.** Off Bounty Islands, 62 m, NZOI stn A748 (4.95 x 4.90 mm). **77.** Off Antipodes Islands, 150 m, NZOI stn A727 (5.80 x 5.60 mm). **78.** Off Otago Heads, 220 m, M.66897 (5.00 x 4.25 mm). **79.** Macquarie Ridge, 128 m (5.90 x 5.55 mm). **80.** Off Tucker Point, Auckland Islands, 26-27 m, M.16755 (5.45 x 5.00 mm). **81.** Protoconch of juvenile paratype of *M. morioria* Powell, off Owenga, Chatham Islands, 18 m, AIM AK71531. **82.** *C. opalus* (Martyn), Castlepoint, littoral. **83.** *M. capillaceus* (Philippi), Ranui Cove, Auckland Islands. **84.** *M. sanguineus* (Gray), McGregors Bay, Whangarei Heads. Scale 81 = 170 μm, 82, 83 = 200 μm, 84 = 100 μm.

shells from beaches, and the few well preserved examples seen were obtained by dredging at 18-70 m (Figs 69-71). Chatham Islands shells show exceptional mosaic variation in shape, sculpture and colour pattern. The spire ranges from low to tall (height/diameter ratio 0.93-1.16), and the spiral cords are very variable in thickness and weakly nodular, gently undulant, or almost smooth. There are five to seven (usually 5 or 6) spiral cords on the penultimate whorl- this number including the abapical spiral, the summit of which is more or less covered by succeeding whorls - and six to ten on the base. The spiral cords may be uniform pink or red throughout; or pink on the first 1.25-1.75 whorls, buff on the next one to two whorls, then pink or red on subsequent whorls, or alternately spotted pink and white on the last two whorls on both the spire and base, or uniform pink or red on the spire and spotted on the base. Three fresh shells taken at 60 m off The Sisters, western Chatham Islands (NMNZ M.69353), are distinctive in having the first 1.5 teleoconch whorls pale pink, and subsequent whorls white with irregular brown maculations, thus resembling some Mernoo Bank specimens. Specimens with very strong spiral cords predominate in samples from beaches, whereas most specimens obtained alive or as unabraided shells by dredging are more weakly sculptured.

Specimens from off the Bounty Islands (Fig. 75) are all broadly conical and resemble Chatham Islands shells in that the spiral cords may be either fully pigmented or spotted, but differ in having seven or eight spiral cords on the adult penultimate whorl instead of five to seven. They combine characteristics of specimens from Chatham Islands (512 km to the north-east) and the Antipodes Islands (205 km to the south).

Specimens from the Antipodes Islands (Fig. 77) and Macquarie Ridge (Fig. 79) are all broadly conical, have eight or nine spiral cords on the adult penultimate whorl, and are distinctive in that the spiral cords are consistently fully pigmented rather than alternately spotted, and in that the outer lip is weakly thickened within at maturity. Specimens from the Antipodes Islands attain the largest size (width up to 7.70 mm). Specimens from Macquarie Ridge are further distinctive in being the most lightly built and finely sculptured, and in that the spiral interspaces are pink, though a paler shade than the spiral cords.

To some degree specimens from the Bounty Islands, Antipodes Islands and Macquarie Ridge are more similar to each other in colour pattern and sculpture than they are to specimens from geographically intermediate Auckland and Campbell islands, whilst specimens from the Antipodes Islands and Macquarie Ridge (1450 km apart) are to some extent more similar to each other than to specimens from the Bounty Islands (only 205 km north of the Antipodes Islands). Unless the differences/similarities are associated with local environmental conditions, they may indicate that there is or has been some eastward gene flow via eggs or larvae carried in currents from Macquarie Ridge, which largely pass south of Campbell Island. This interpretation is accordant with the known circulation pattern of the Antarctic Circumpolar Current (Nowlin and Klinck, 1986) (Fig. 41), which evidently accounts for the distribution of forms of *M. capillaceus* (see above). Exceptional variation in the Chatham Islands population may be due to intermittent genetic input from both the west (Otago and western Chatham Rise via the Southland Current) and the

south-west (Bounty and Antipodes Islands).

Two old-looking shells obtained at NZOI station D139, south of The Snares at 150 m (48°20.5'S, 167°46.5'E), from a substratum of rocks, bryozoans and shell, differ from fresh specimens from the same sample and other shells from the vicinity in having banded rather than spotted spiral cords and finer nodules. Colour pattern and sculpture resemble that of shells from the Bounty and Antipodes Islands and Macquarie Ridge, and the outer lip is heavily internally thickened as in specimens from localities other than the Antipodes Islands and Macquarie Ridge. These occurred together with two specimens of *M. capillaceus* in similar condition (see above) and presumably date from the last glacial maximum when the sea was cooler and at a lower level.

Since it seems impossible to justify taxonomic segregation of the Chatham Islands or Otago forms from topotypes and other forms of *M. mortenseni, M. sanguineus morioria* and *M. caelatus archibenthicola* are interpreted as synonyms.

Acknowledgements

For loan of type and other material I am grateful to A.G. Beu and I. Keyes (Institute of Geological and Nuclear Sciences, Lower Hutt), P. Bouchet and V. Heros (Muséum National d'Histoire Naturelle, Paris), B. Hayward (Auckland Institute and Museum), I. Loch (Australian Museum, Sydney), M.S. Morley (Auckland), C. Muir (Canterbury Museum, Christchurch), S. O'Shea (National Institute of Water and Atmospheric Research, Wellington), G. Rosenberg (Academy of Natural Sciences, Philadelphia), T. Schiotte (Zoological Museum, Copenhagen), E.M. Turner (Tasmanian Museum, Hobart) and K.M. Way (BMNH). For the collecting of much material I am grateful to K. Burch (Whangarei), D. Gibbs (late of Auckland), P.R. Jamieson (late of Wellington), B. Noye (Christchurch), N.J. Peterson (Tauranga), J.L. Raven (Wellington), and C.D. Paulin, C.D. Roberts and A.L. Stewart (Museum of New Zealand, Wellington). For comments on the manuscript I am grateful to A.G. Beu, and D.G. Herbert (Natal Museum, Pietermaritzburg). Thanks also to M.J. Chappell (Royal New Zealand Navy Hydrographic Office, Auckland) for early hydrographic charts, C.D. Paulin and C.D. Roberts (Museum of New Zealand) for discussions of hydrological and ecological conditions in Fiordland, B. Stanton (National Institute of Water and Atmospheric Research, Wellington) for discussion of oceanic circulation patterns in the Southern Ocean, P. Parkinson (Alexander Turnbull Library, Wellington) for advise on Latin grammar, W. St. George (Institute of Geological and Nuclear Sciences, Lower Hutt) and R. Thompson (Victoria University, Wellington) for access to scanning electron microscopes, and to N. Heke and M. Hall (Museum of New Zealand) for the photography and photographic printing respectively. Much material from Fiordland was obtained through generous grants from the New Zealand Lottery Board.

References

Adams, A. 1853. Contributions towards a monograph of the Trochidae, a family of gasteropodous Mollusca. *Proceedings of the Zoological Society of London* **19 (1851):** 150-192.

Adams, N.M. & Nelson, W.A. 1985. The marine algae of the Three Kings Islands. A list of species. *National Museum of New Zealand Miscellaneous Series* **13**. 29pp.
Beu, A.G. & Maxwell, P.A. 1990. Cenozoic Mollusca of New Zealand. *New Zealand Geological Survey Paleontological Bulletin* **58**. 518pp.
Boreham, A. 1959. Biological type specimens in the New Zealand Geological Survey. 1. Recent Mollusca. *New Zealand Geological Survey Paleontological Bulletin* **30**. 75pp.
Cernohorsky, W.O. 1977. The taxonomy of some molluscan species reported from New Zealand. *Records of the Auckland Museum* **14**: 87-104.
Chemnitz, J.H. 1781. Neues systematisches Conchylien Cabinet 5. Raspe, Nuremberg. 324pp.
Cotton, B.C. 1959. South Australian Mollusca. Archaeogastropoda. Government Printer, Adelaide. 449pp.
Crozier, M.A. 1966. New species and records of Mollusca from off Three Kings Islands, New Zealand. *Transactions of the Royal Society of New Zealand, Zoology* **8 (5)**: 39-49.
Dell, R.K. 1956. The archibenthal Mollusca of New Zealand. *Dominion Museum Bulletin* **18**. 235pp.
Dell, R.K. 1963. Notes of some New Zealand Mollusca in the British Museum. *Transactions of the Royal Society of New Zealand. Zoology* **3(17)**: 171-177.
Dell, R.K. 1964. Marine Mollusca from Macquarie and Heard islands. *Records of the Dominion Museum* **4**: 267-301.
Dillwyn, L.W. 1817. A descriptive catalogue of Recent shells, arranged according to the Linnaean method; with particular attention to the synonymy. 2. Arch, London: 581-1092.
Finlay, H.J. 1926. A further commentary on New Zealand molluscan systematics. *Transactions of the New Zealand Institute* **57**: 320-485.
Finlay, H.J. 1928. The Recent Mollusca of the Chatham Islands. *Transactions of the New Zealand Institute* **59**: 232-286.
Fischer, P. 1875-1880. Spécies général et iconographie des coquilles vivantes, comprenant la collection du Muséum d'Histoire Naturelle de Paris, la collection Lamarck, celle du Prince Massene, et les découvertes récentes des voyageurs. 11. Baillière, Paris. 480pp.
Fischer, P. 1878. Diagnoses trochorum novorum. *Journal de Conchyliologie* **26**: 62-67.
Fischer, P. 1880-1887. Manuel de conchyliologie et de paléontologie conchyliologique ou histoire naturelle des mollusques vivants et fossiles... Savy, Paris. 1369pp.
Fleming, C.A. 1948. New species and genera of marine Mollusca from the Southland Fiords. *Transactions of the Royal Society of New Zealand* **77**: 72-92.
Fleming, C.A. 1950. The molluscan fauna of the fiords of Western Southland (A report on the New Golden Hind Expedition, 1946). *New Zealand Journal of Science and Technology* **5**: 20-40.
Fleming, C.A. 1951. Some Australasian Mollusca in the British Museum (Natural History). *Transactions of the Royal Society of New Zealand* **79**: 126-139.
Fleming, C.A. 1958. A new species of Sigapatella (Gastropoda) from Cape Maria van Diemen, Northland, New Zealand. *Records of the Dominion Museum* **3**: 141-143.
Gmelin, J.F. 1791. Caroli a Linné... Systema naturae per regna tria naturae, secundum classes... Editio decima tertia, aucta, reformata 1 (6). Vermes testacea. Beer, Lipsiae: 3021-4120.
Gould, A.A. 1849. [Shells collected by the United States Exploring Expedition under the Command of Charles Wilkes.] *Proceedings of the Boston Society of Natural History* **3**: 89-92.
Gould, A.A. 1852. Mollusca and Shells. United States Exploring Expedition during the years 1839-1842 under the command of Charles Wilkes, U.S.N. 12. Gould and Lincoln, Boston. 510pp.

Grange, K.R., Singleton, R.J., Richardson, J.R., Hill, P.J. & Main, W.DeL. 1981. Shallow rock-wall biological associations of some southern fiords of New Zealand. *New Zealand Journal of Zoology* **8:** 209-227.

Gray, J.E. 1843. Catalogue of the species of Mollusca and their shells, which have hitherto been recorded as found at New Zealand, with the description of some lately discovered species. Appendix 4, pp 228-265 in Dieffenbach, E., Travels in New Zealand; with contributions to the geography, geology, botany, and natural history of that country. 2. Murray, London.

Habe, T. 1959. Radulae of four gasteropods from South Australia and New Zealand. *Journal of the Malacological Society of Australia* **1 (3):** 37-38.

Hedley. C. 1906. On some eighteenth-century names that relate to New Zealand Mollusca. *New Zealand Colonial Museum Bulletin* **1:** 48-49.

Hedley, C. 1916. Mollusca. *Australasian Antarctic Expedition 1911-1914. Scientific Reports C* **(4) 1:** 80pp.

Hedley, C. 1920. A revised name for a New Zealand trochoid. *New Zealand Journal of Science and Technology* **3:** 54.

Herrmannsen, A.N. 1846-47. Indicis generum malacozoorum primordia....1. Fisheri, Cassellis. 637pp.

Hickman, C.S. & McLean, J.H. 1990. Systematic revision and suprageneric classification of trochacean gastropods. *Natural History Museum of Los Angeles, Science Series* **35.** 169pp.

Hickman, C.S. 1992. Reproduction and development of trochacean gastropods. *The Veliger* **35:** 245-272.

Higo, S. & Goto, Y. 1993. A systematic checklist of molluscan shells from the Japanese Is. and adjacent area. Elle Scientific Publications, Osaka. 22+693+13+148pp

Hombron, J.B. & Jacquinot, C.H. 1854. Description des mollusques coquilles et zoophytes. In Rousseau, L. (ed.) Voyage au Pole Sud et dans l'Océanie sur les corvettes l'Astrolabe et la Zélée; execute par ordre du Roi pendant les anées 1837-1838-1839-1840, sous le commandement de M.J. Dumont-Durville, capitaine de vaisseu, commandant de la Zélée. Zoologie 5. Gide and Baudry, Paris. 132pp.

Hutton, F.W. 1873. Catalogue of the marine Mollusca of New Zealand, with diagnoses of the species. Didsbury, Government Printer, Wellington. 116pp.

Hutton, F.W. 1878. Révision des coquilles de la Nouvelle-Zélande et des Îles Chatham. *Journal de Conchyliologie* **26:** 5-57.

Hutton, F. W. 1880. Manual of the New Zealand Mollusca. A systematic and descriptive catalogue of the marine and land shells, and of the soft mollusks and Polyzoa of New Zealand and the adjacent islands. Hughes, Government Printer, Wellington. 224pp.

Hutton, F.W. 1883. Notes on some branchiate gastropods. *Transactions of the New Zealand Institute* **15:** 118-131.

Hutton F.W. 1884. Revision of the Recent rhipidoglossate and docoglossate Mollusca of New Zealand. *Proceedings of the Linnean Society of New South Wales* **9:** 354-378.

ICZN, 1985. International Code of Zoological Nomenclature. Third Edition adopted by the 20th General Assembly of the International Union of Biological Sciences. International Trust for Zoological Nomenclature in association with British Museum (Natural History) London. University of California Press, Berkeley. 338pp.

ICZN Opinion 479 (1957). Validation under the plenary powers of specific names for nine species of the class Gastropoda occurring in the New Zealand area as published by Martyn (T.) in 1784 in the work entitled "The Universal Conchologist". *Opinions and Declarations Rendered by the International Commission on Zoological Nomenclature* **16:** 367-416.

Iredale, T. 1915. A commentary on Suter's "Manual of the New Zealand Mollusca". *Transactions of the New Zealand Institute* **47:** 417-497

Keen, A.M. 1960. In Moore, R.C. (ed.) Treatise on invertebrate paleontology. Part I, Mollusca 1. Geological Society of America and University of Kansas Press. 351pp.

Kiener, L.C. 1850. Spécies général et iconographie des coquilles vivantes, comprenant la collection du Muséum d'Histoire naturelle de Paris, la collection Lamarck, celle du Prince Massene, et les découvertes récentes des voyageurs. Genre *Trochus* (plates only). Baillière, Paris.

Kuroda, T., Habe, T. & Oyama, K. 1971. The seashells of Sagami Bay. Maruzen, Tokyo. 16 + 741 + 489 + 51pp.

Marshall, B.A. 1977. The Recent New Zealand species of *Triforis* (Gastropoda: Triforidae). *New Zealand Journal of Zoology* **4:** 101-110.

Marshall, B.A. 1978. Cerithiopsidae (Mollusca: Gastropoda) of New Zealand, and a provisional classification of the family. *New Zealand Journal of Zoology* **5:** 47-120.

Marshall, B.A. 1979. Additional dextral triphorids (Mollusca: Gastropoda) from New Zealand. *New Zealand Journal of Zoology* **6:** 397-404.

Marshall, B.A. 1983. Recent and Tertiary Seguenziidae (Mollusca: Gastropoda) from the New Zealand region. *New Zealand Journal of Zoology* **10:** 235-262.

Marshall, B.A. 1988. Thysanodontinae: A new subfamily of the Trochidae (Mollusca: Gastropoda). *Journal of Molluscan Studies* **54:** 215-229.

Marshall, B.A. 1993. The systematic position of *Larochea* Finlay, 1927, and introduction of a new genus and two new species (Mollusca: Gastropoda: Scissurellidae). *Journal of Molluscan Studies* **59:** 285-294.

Marshall, B.A. 1995a. Recent and Tertiary Trochaclididae from the southwest Pacific (Mollusca: Gastropoda: Trochoidea). *The Veliger* **38:** 92-115.

Marshall, B.A. 1995b. A revision of the Recent Calliostomatidae of New Zealand (Mollusca: Gastropoda: Trochoidea). *The Nautilus* **108:** 83-126.

Martyn, T. 1784. The universal conchologist, exhibiting the figure of every known shell accurately drawn and painted after nature: with a new systematic arrangement by the author Thomas Martyn. 1. Martyn, London. 40pp.

Menke, T. 1828. Synopsis methodica molluscorum generum omnium et specierum earum, quae in museo Menkeano adservantur; cum synonymia critica et novarum specierum diagnosibus. Uslar, Pyrmonti.

Montfort, D.de 1810. Conchyliologie systématique, et classification méthodique des coquilles; offrant leurs figures, leur arrangement générique, leurs descriptions caractéristiques, leur noms; ainsi que leur synonymie en plusieurs langues. 2. Coquilles univalves, non cloisonnées. Schoell, Paris. 676pp.

Natusch, S. 1978. The cruise of the Acheron. Her Majesty's Steam Vessel on survey in New Zealand waters 1848-51. Whitcoulls, Christchurch. 190pp.

Nelson, C.S., Hancock, G.E. & Kamp, P.J.J. 1982. Shelf to basin, temperate skeletal carbonate sediments, Three Kings Plateau, New Zealand. *Journal of Sedimentary Petrology* **52:** 717-732.

Nelson, C.S. & Hancock, G.E. 1984. Composition and origin of temperate skeletal carbonate sediments on South Maria Ridge, northern New Zealand. New Zealand *Journal of Marine and Freshwater Research* **18:** 221-239.

Nowlin, W.D. & Klinck, J.M. 1986. The physics of the Antarctic Circumpolar Current. *Reviews of Geophysics* **24:** 469-491.

Odhner, N. 1924. New Zealand Mollusca. Papers from Dr Th. Mortensen's Pacific Expedition 1914-16. 19. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening; Kjobenhavn* **77.** 1-90.

Perry, G. 1811. Conchology, or the natural history of shells: containing a new arrangement of the genera and species, illustrated by coloured engravings executed from the natural specimens, and including the latest discoveries. Miller, London. 4pp, captions to 61 plates.

Philippi, R.A. 1846-1855. [*Trochus, Xenophorus*] In Küster, H.C. and Kobelt, W. (eds.) Systematisches Conchylien-Cabinet von Martini und Chemnitz... 2 (3). Bauer and Raspe, Leipzig. 372pp.

Philippi, R.A. 1849. Centuria altera testaceorum novorum. *Zeitschrift für Malakozoologie* **5:** 99-112.

Pilsbry, H.A. 1889-1890. Manual of conchology; structural and systematic, with illustrations of the species. 11. Academy of Natural Sciences, Philadelphia. 519pp.

Ponder, W.F. 1965a. The family Eatoniellidae in New Zealand. *Records of the Auckland Institute and Museum* **6:** 47-99.

Ponder, W.F. 1965b. A revision of the New Zealand Recent and fossil species of *Estea* Iredale, 1915. *Records of the Auckland Institute and Museum* **6:** 131-161.

Ponder, W.F. 1968. Notes on New Zealand prosobranchs with descriptions of new species and subspecies. *Records of the Dominion Museum* **6:** 113-124.

Powell, A.W.B. 1933. The marine Mollusca of the Chatham Islands. *Records of the Auckland Institute and Museum* **1:** 181-208.

Powell. A.W.B. 1937. The shellfish of New Zealand. An illustrated handbook. Unity Press, Auckland. 100pp.

Powell, A.W.B. 1940. The marine Mollusca of the Aupourian Province. *Transactions of the Royal Society of New Zealand* **70:** 205-248.

Powell, A.W.B. 1946a. The shellfish of New Zealand. An illustrated handbook (2nd edition). Whitcombe and Tombs, Christchurch. 106pp.

Powell, A.W.B. 1946b. New species of New Zealand Mollusca from the South Island, Stewart Island, and Chatham Islands. *Records of the Auckland Institute and Museum* **3:** 137-144.

Powell, A.W.B. 1955. Mollusca of the southern islands of New Zealand. *Cape Expedition - Scientific results of the New Zealand Sub-Antarctic Expedition, 1941-45. Bulletin* **15.** 151pp.

Powell, A.W.B. 1957. Shells of New Zealand. An illustrated handbook (3rd edition). Whitcombe and Tombs, Christchurch. 202pp.

Powell, A.W.B. 1962. Shells of New Zealand. An illustrated handbook (4th edition). Whitcombe and Tombs, Christchurch. 203pp.

Powell, A.W.B. 1976. Shells of New Zealand. An illustrated handbook (5th edition). Whitcoulls, Christchurch. 154pp.

Powell, A.W.B. 1979. New Zealand Mollusca. Marine, land and freshwater shells. Collins, Auckland. 500pp.

Schaufuss, L.W. 1869. Molluscorum systema et catalogus. System und Aufzählung sämmtlicher Conchylien der Sammlung von Fr. Paetel.... Weske, Dresden. 119pp.

Simpson, R.D. 1976. Physical and biotic factors limiting the distribution and abundance of littoral molluscs on Macquarie Island (Sub-Antarctic). *Journal of Experimental Marine Biology and Ecology* **21:** 11-49.

Simpson, R.D. 1977. The reproduction of some littoral molluscs from Macquarie Island (Sub-Antarctic). *Marine Biology* **44:** 125-142.

Smith, E.A. 1874. Mollusca. In Richardson, J. and Gray, J.E. (eds.). The zoology of the voyage of H.M.S. Erebus and Terror, under the command of Captain Sir James Clark Ross, R.N., F.R.S., during the years 1839 to 1843. Jason, London. 7pp.

Smith, E.A. 1876. A list of marine shells, chiefly from the Solomon Islands, with descriptions of several new species. *Journal of the Linnean Society of London* **12:** 535-562.

Smith, E.A. 1894. On some new species of shells from New Zealand and Australia, and remarks upon some forms occurring in deep-water off Sydney. *Proceedings of the Malacological Society of London* **1:** 57-60.

Smith, E.A. 1902. Mollusca. Pp 201-213. Report on the collections of natural history made in the Antarctic regions during the voyage of the "Southern Cross". London.

Smith, E.A. 1915. Mollusca. Part 1.- Gastropoda Prosobranchia, Scaphopoda, and Pelecypoda. *British Antarctic ("Terra Nova") Expedition, 1910. Natural History Report. Zoology* **2 (4):** 61-112.

Sowerby, G.B. 1870. Descriptions of forty-eight new species of shells. *Proceedings of the Zoological Society of London* **1870:** 249-259.

Spalowsky, J.J.N.A. 1795. Prodromus in systema historicum testaceorum. Vorschmack einer vollständigen Systematischen Geschichte der Schalthiergehause. Alberti, Wien. 88pp.

Stanton, B.R. 1973. Hydrological investigations around northern New Zealand. *New Zealand Journal of Marine and Freshwater Research* **7:** 85-110.

Suter, H. 1897. Revision of the New Zealand Trochidae. *Proceedings of the Malacological Society of London* **2:** 260-290.

Suter, H. 1904. Mollusca. Pp 57-95 in Hutton, F.W. (ed.), Index faunae Novae Zealandiae. Dulau, London. 372pp.

Suter, H. 1908. Additions to the marine molluscan fauna of New Zealand, with descriptions of new species. *Proceedings of the Malacological Society of London* **8:** 22-42.

Suter, H. 1913. Manual of the New Zealand Mollusca. With an atlas of quarto plates [1915]. Mackay, Government Printer, Wellington. 1120pp.

Swainson, W. 1840. A treatise on malacology, or shells and shell-fish. Longman, Orme, Brown, Green, Longmans and Taylor, London. 419pp.

Tate, R. & May, W.L. 1901. A revised census of the marine Mollusca of Tasmania. *Proceedings of the Royal Society of New South Wales* **26:** 344-471.

Tenison Woods, J.E. 1877. On some new Tasmanian marine shells [second series]. *Monthly Notices of Papers and Proceedings and Report of the Royal Society of Tasmania* **1876:** 131-159.

Tenison Woods, J.E. 1878. Census; with brief descriptions of the marine shells of Tasmania and the adjacent islands. *Monthly Notices of Papers and Proceedings and Report of the Royal Society of Tasmania* **1877:** 26-57.

Thiele, J. 1929. Handbuch der Systematischen Weichtierkunde 1 (1). Fischer, Jena. 1-376.

Tomlin, J.R.le B. 1948. The Mollusca of Macquarie Island: gastropods and bivalves. *British, Australian and New Zealand Antarctic Research Expedition, 1929- 1931 B* **(5) 5:** 221-232.

Walch, J.E. I. 1774. Beschreibung einiger neuentdeckten Conchylien. *Der Naturforscher* **4:** 33-56.

Walsby, J. & Morton, J. 1982. Marine molluscs. Part 1. Amphineura, Archaeogastropoda and Pulmonata. Leigh Marine Laboratory. University of Auckland. 88pp.

Wenz, W. 1938. Gastropoda. Teil 1: Allgemeiner Teil und Prosobranchia 2 (3): 241-480. In Schindewolf, O.H. (ed.) Handbuch der Paläozoologie 6. Borntraeger, Berlin.

Willan, R.C. 1978. The molluscan genus *Cominella* (Gastropoda: Buccinidae) at the Three Kings Islands. *New Zealand Journal of Zoology* **5:** 437-443.

Willan, R.C. 1988. Description of a new aeolid nudibranch (Mollusca: Opisthobranchia) belonging to the genus *Phidiana*. *New Zealand Journal of Zoology* **14:** 409-417.

Wilson, B. 1993. Australian marine shells. Prosobranch gastropods part one. Odyssey, Kallaroo. 408pp

Woodward, S.P. 1851-1856. A manual of the Mollusca; or, rudimentary treatise of Recent and fossil Shells. Weale, London. 486pp.

Zorn von Plobsheim, F.A. 1775. Beschreibung einiger seltnen Conchylien aus Sammlung der naturforschenden Gesellschaft zu Danzig. *Der Naturforscher* **7**: 151-168.

Key to New Zealand *Cantharidus* and *Micrelenchus* species

1. Shell with strong flexure at base of inner lip, height up to 53 mm - *Cantharidus opalus* (Figs 1-4, 9).

Shell with weak flexure or no flexure at base of inner lip, height less than 32 mm - 2

2. Shell with strong axial sculpture between spiral cords on early teleoconch whorls (Figs 10, 11), and spiral threads on strong spiral cords - 3

Shell with no axial sculpture, or fine, crowded axial riblets between spiral cords (Fig. 65) - 4

3. Axial riblets rounded at first, transforming into crisp imbricating lamellae, pigmentation on early whorls typically confined to summits of spiral cords, up to 31 mm high - *Cantharidus purpureus* (not at Three Kings Islands) (Figs 5-7, 10).

Axial riblets rounded throughout, pigmentation on early whorls traversing spiral interspaces, up to 27.5 mm high (Three Kings Islands only) - *Cantharidus burchorum* (Figs 8, 11)

4. Spiral sculpture weak (as in Figs 45, 47) - 5

Spiral sculpture of strong cords - 7

5. Shell up to 29 mm high, never maculated, spiral cords typically blackish, occasionally reddish (subantarctic islands only) - *Micrelenchus capillaceus* (Figs 34-39, 42).

Shell less than 12 mm high, typically maculated, never blackish - 6

6. Shell up to 11.50 mm high (not north of Cape Reinga) - *Micrelenchus dilatatus* (Figs 43, 45)

Shell up to 6.20 mm high, weaker sculpture than *M. (P.) dilatatus* (north of Cape Reinga only) - *Micrelenchus festivus* (Figs 44, 46, 47).

7. Spiral cords greenish, brownish or black, early teleoconch whorls not yellow or pink - 8

Spiral cords variably coloured; if greenish, brownish or black, early teleoconch whorls yellow or pink - 9

8. Dull. Spiral cords black, commencing at start of second teleoconch whorl (littoral, typically on intertidal *Zostera* flats) - *Micrelenchus huttonii* (Figs 25, 31-33).

Glossy. Spiral cords green, grey or brown, commencing after second teleoconch whorl (littoral, never living on intertidal mudflats) - *Micrelenchus tenebrosus* (Figs 20-23, 28).

9. Spiral cords distinctly nodular - 10
Spiral cords smooth or at most very weakly beaded on early whorls - 11
10. Early teleoconch whorls yellow, or pinkish with a yellow flush, spiral cords on later whorls red-spotted, nodules weak (sublittoral, south-eastern South Island only) - *Micrelenchus caelatus* (Figs 67, 68).
Early teleoconch whorls white or pink, spiral cords on later whorls typically red or red-spotted, nodules weak or strong (sublittoral, Chatham Rise, south-eastern South Island, and subantarctic islands) - *Micrelenchus mortenseni* (Figs 69-80).

11. Spiral interspaces smooth, colour and colour pattern variable - *Micrelenchus sanguineus* (Figs 17-19).
Spiral interspaces on last few whorls with fine, crowded axial riblets (Fig. 65) - 12

12. Periphery evenly rounded, 5-7 spiral cords on penultimate whorl, spiral interspaces considerably wider than spiral cords, spiral cords typically red (sublittoral, north-eastern and south-western North Island, and western Cook Strait) - *Micrelenchus rufozona* (Fig. 58-60, 65)
Periphery evenly rounded or bulging, 6-14 spiral cords on penultimate whorl (typically 8-14), spiral interspaces typically narrower than spiral cords, colour and colour pattern variable (sublittoral, southern North Island, South Island, and Stewart Island) - *Micrelenchus artizona* (Figs 53-57).

Molluscan Research **19(1):** 157-159 *(1988)*

Short Communication

Note on the identity of *Haliotis clathrata* Lichtenstein, 1794 (not Reeve, 1846)

Daniel L. Geiger

Department of Biological Sciences, University of Southern California,
Los Angeles, CA 90089-0371, USA.
e-mail: dgeiger@scf.usc.edu

Haliotis clathrata Lichtenstein, 1794, is a senior homonym of *H. clathrata* Reeve, 1846. Geiger & Stewart (under consideration) have petitioned the International Commission on Zoological Nomenclature to suppress *H. clathrata* Lichtenstein in order to preserve two rather well known taxa: the junior homonym *H. clathrata* Reeve, which is discussed in detail by Stewart & Geiger (in press), and the junior synonym *H. elegans* Philippi, 1844. Here I present the arguments for the synonymy between *H. clathrata* Lichtenstein and *H. elegans*. The work of Lichtenstein is discussed in Kerzhner (1994) and Geiger & Stewart (under consideration). The approximately 200 species-level taxa within the Haliotidae are dealt with in Geiger (in press).

Haliotis clathrata Lichtenstein has so far been considered a *nomen dubium* (Wagner & Abbott, 1978), particularly because Lichtenstein (1794) is an exceedingly rare work, and had been written in Latin and archaic German. I base my discussion on a microfilm copy available at the University of California, Berkeley. The whereabouts of Lichtenstein's specimens are unknown.

Original description of *H. clathrata* Lichtenstein (1794)

;1228! *Haliotis clathrata, nobis. Haliotis testa ovata striis longitudinalibus & transversis tuberculatis versicoloribus. Discus longitudinaliter pertusus poris modo quinque, quorum ultimus 7/8 pollic. ab extremo canaliculo aperturae distat. Labium externum profunde denticulatum. Superficies testae tuberculis granulato - unguiculatis imbricata. Habitat in nova Hollandia ab sinum botanicum.*

Ein bisher noch unbekanntes See-Ohr vom Botany Bay, diese Schnecke gleicht der vorhergehenden nach ihrer inneren Wand an Glanz und Schönheit, und da solche gegittert ist, so zeigt sich gleichsam verschiedene bey einander liegenden Perlen Schnüre, von reitzenden Farben, indem sie an taubenhalsigen und [p]fauenschweiffigen Schimmer erster nichts nach giebt, die Schnecke hat nur 5 offene Löcher, und sie weicht von allen anderen dieses Geschlechtes davon ab, dass solche nicht bis zum Ende des äusseren Mündungs-Canal hinaus laufen, sondern die letzte grösste 7/8 Zoll davon entfernt ist; die äussere Lippe ist mit starken Einschnitten gezähnt, die Unterfläche ziegt den schönsten Perlmutter-Glanz, auf der Oberfläche liegen erhabene Perlenschnüre bey einander, welche aus Hohlziegeln oder Nägeln bestehen, (höchstselten.)"

Translation: 1228 ! *Haliotis clathrata*, by us. An abalone with an oval shell bearing longitudinal strings and transverse tubercles of various colors. The disc is

perforated longitudinally with only 5 holes, of which the last one is 7/8 inches away from the external canal of the aperture. The outer lip is deeply serrated. The surface of the shell is covered in granulated and fingernail-like tubercles. Lives in Australia in the Bay of Botany [just south of Sydney, New South Wales: 13°04' S, 151°08' E]

A so far still unknown abalone [literally: sea ear] from Botany Bay, this snail is similar to the previous [1226-1227: *H. iris* Gmelin, 1791] in its inner wall in respect to shine and beauty, and because it is reticulated, therefore shows so to speak different closely adjacent stings of pearls, of delightful colors, by which they are in no way inferior to the pigeon neck and the peacock-tail glitter of the first one, the shell has 5 open holes, and it differs from all others of this genus that these do not extend to the end of the outer apertural canal, but the last largest is 7/8 inches therefrom away; the outer lip is serrated with strong incisions, the under side shows the nicest nacreous shine, on the surface elevated strings of pearls lay together, which are composed of hollow tiles or fingernails, (exceedingly rare.)

Identity of *H. clathrata* Lichtenstein.

The species described does not refer to *H. clathrata* Reeve, ruling out an erroneous attribution of Lichtenstein's species to Reeve. *H. clathrata* Reeve does not have the elevated scales mentioned in the description of *H. clathrata* Lichtenstein. The sculpture of *H. clathrata* Reeve consists of fine spiral cords, and may have additional radial folds. Several characters of *H. clathrata* Lichtenstein point to *H. elegans* Philippi, 1844: the type locality in temperate Australia, the numerous hollow scales, which are arranged in parallel rows, and the fact that the last open perforation is not close to the apertural margin (cf. Geiger, 1991: fig. 8; Wilson, 1993: pl. 3 fig. 2B), a fairly constant feature in larger specimens of this species and only known to occur occasionally in other abalone species (Geiger, 1991: fig 8 shows *H. gigantea* Gmelin, 1791, *H. midae* Linnaeus, 1758, *H. tuberculata* Linnaeus, 1758; Geiger, pers. obs.: *H. pulcherrima* Gmelin, 1791). The number of open perforation falls in the range commonly encountered in *H. elegans*, although little weight should be given to this character. The dorsal side of the shell is described as being of various colors, whereas *H. elegans* usually has a constant shell color; a dull brick-red covers rather smoothly the entire shell, except occasionally for the spire, which may be eroded exposing some nacre, but some mottled specimens have been seen by the present author. Only one character does not agree with such an identification. The nacre of *H. iris* from New Zealand, to which *H. clathrata* Lichtenstein is compared, is very dark, but is rather light in *H. elegans*. However, Lichtenstein's comparison rather referred to the beauty and freshness of the two specimens and not to the color of the nacre. Additionally, the type locality is not within the present day known distribution of the species, which spans from Esperance to Fremantle and Geraldton, Western Australia (Wells & Bryce, 1985; Wilson, 1993). Inconsistencies in type localities are common in the older literature, as shown for *H. unilateralis* Lamarck, 1822, and *H. squamosa* Gray, 1826, both with type locality of Australia, but restricted occurrence in the Red Sea and Southern Madagascar, respectively (Dautzenberg, 1932; Stewart, 1984; Geiger, 1996; in press). Despite

these small inconsistencies, the overwhelming majority of the clear evidence indisputably indicates, that *H. clathrata* Lichtenstein is synonymous with *H. elegans*.

References

Dautzenberg, P. 1932. Mollusque testacés marins de Madagascar. Supplément [Shelled Marine Mollusks of Madagascar. Supplement]. *Journal de Conchylilogie*, **76:** 5-119.

Geiger, D. 1991. Einige Aspekte über die Biologie von *Haliotis*. *Club Conchylia Informationen* **23:** 87-108.

Geiger, D. 1996. Haliotids in the Red Sea, with neotype designation for *Haliotis unilateralis* Lamarck, 1822 (Gastropoda: Prosobranchia). *Revue Suisse de Zoologie*, **103:** 339-354.

Geiger, D. L. (in press). Recent genera and species of the family Haliotidae Rafinesque, 1815 (Gastropoda: Vetigastropoda). *The Nautilus*.

Geiger, D. L. & Stewart, K. A. (under consideration). Suppression of *Haliotis clathrata* Lichtenstein, 1794 to preserve *H. clathrata* Reeve, 1846 and *H. elegans* Philippi, 1844. (Gastropoda, Prosobranchia). *Bulletin of Zoological Nomenclature*.

Kerzhner, I. M. 1994. Case 2862. A.A.H. Lichtenstein's (1796, 1797) *Catalogus musei zoologici ... Sectio tertia. Continens Insecta* and D.H. Schneider's (1800) Verzeichniss einer Parthei Insekten ...: proposed suppression, with conservation of some Lichtenstein (1796) names (Insecta and Arachnida).*Bulletin of Zoological Nomenclature*, **51:** 108-115.

Lichtenstein, A. A. H. 1794. *Catalogus rerum naturalium rarissimum. Sectio secunda continens Conchylia, item mineralia, ligna exotica, & arte parata*. G. F. Schniebes, Hamburg.

Stewart, K. 1984. Notes on *Haliotis squamosa* Gray, 1827. *Shells and Sea Life*, **16:** 92-95.

Stewart, K. A., & Geiger, D. L. (in press). Designation of lectotype for *Haliotis crebrisculpta* Sowerby, 1914, with a discussion of *H. clathrata* Reeve, 1846 (*non* Lichtenstein, 1794). *The Veliger*.

Wagner, R. J., & Abbott, R. T. 1978. Standard Catalog of Shells, Third Edition. American Malacologists, Greenville.

Wells, F. E. & Bryce, W. 1985. Seashells of Western Australia. Western Australian Museum, Perth.

Wilson, B. 1993. Australian Marine Shells 1. Odyssey Publishing, Kallaroo.

Book Review

***Mollusca: The Southern Synthesis*, Parts A & B**
***Fauna of Australia, Vol. 5*, 1998. CSIRO Publishing, Melbourne.**

Publication of this remarkable work represents a sharp focal point in the history of malacology in Australia, bringing together all that has gone before, placing it into the context of malacologal knowledge developed globally, and providing a synthesis that forms a comprehensive base of future studies.

At the outset I must draw attention to one of the few difficulities I have in using these books. The work is cited as a "volume" and yet it consists of two books, Part A and Part B, that would normally be cited as two volumes. It is hard to be consistent about referring to them, in the singular or the plural. But that is a very minor problem. In content, production standard and usefulness these books have no equal.

The scope of the work is breathtaking. Everything known at this time about Australian molluscs - their scientific history, evolutionary history, classification, morphology, physiology, ecology, biogeography, larval development, utilsation - everything is included, and in the minutest detail. Furthermore, the sections are written by the foremost experts in the respective fields. There has never been a publication on molluscs that has attempted to cover the field of malacology so comprehensively or with such authoratitiveness.

The vision of the *Fauna of Australia* series was conceived more than 20 years ago when the Australian Biological Resources Study was established by the Commonwealth Government. It was envisaged as an encyclopedial account of the Australian marine and terrestrial faunas that would serve as a basic reference for environmental science for decades to come reflecting "the deep and varied interests of all Australians in their magnificant and unique island continent".

The original editorial committees were aware of the magnitude of the task that they had undertaken and the fact that the project would turn out to be so arduous would be no surprise to them. In the foreword to the first volume (General Articles, 1987) it was noted that "meaningful descriptions to many families would be difficult because of the dearth of information". Accordingly, "production of the volumes containing the poorest known groups would be delayed until the 1990's". Acknowledging that the Mollusca was one of the better known invertebrate groups in Australia, this great phylum was selected for early treatment. And here we are, near the end of the 1990's and the molluscan volumes are finally produced. (Let us hope that the volumes on the "poorest known groups" do not take a proportionately long time to complete.)

The truth is that, in the 200 years and more since malacological science began in what is now Australian territory, far more knowledge has been gathered about Australian molluscs than anyone had imagined. The task of pulling it all together turned out to be formidable. Yet there they stand on our library shelves, two beautiful volumes that are a testimony to the efforts of

generations of people who devoted so much of their attention to the study of Australian molluscs as well as to the efforts of the authors and editors who struggled so hard to synthesise it all into one publication.

An important point to make, however, is that these volumes have a much wider relevance than solely Australian molluscs. The scope of the work is such that it will serve as a comtemporary account of malacological knowledge worldwide. In the first place, many Australian marine molluscs are widely distributed beyond Australian territory. Also, the focus of these books is largely on higher taxa, that is, family level and above. At this level, all but a few Australian endemic taxa are distributed globally. Conversely, for many molluscan families there is little or no information about Australian species. It is a feature of these books that, when higher taxon level information is not available from studies of Australian species, information on foreign relatives has been "imported" to complete the taxonomic coverage. Consequently, much of the content of these volumes has global relevance. They are truly a "southern synthesis" but one which will be almost as useful in the other hemisphere.

Who will use these books? It should not be supposed that they are for the lay reader and they are not for bed-side reading. They are jammed full of technical information. A sincere effort has been made by the editors to make the text readable by non-specialist malacologists and zoologists but the nature of the material is such that readers with no technical background will find these books hard going. Nevertheless, they are an extraordinarily valuable source of information about molluscs. Researchers, environmentalists, students and collectors will find in them anything and everything that is known about Australian molluscs at this time.

Three of the most impressive and useful features of the books, as an information resource, are the comprehensive bibliographies, the index and the glossary. In order to minimise duplication, the references are consolidated at the end of each chapter, even though the chapters are generally multiauthored. The index and glossary are given at the end of Part B. Both are detailed and extremely helpful.

While it is not intended as a criticism, an anomaly in the layout of these books is the degree of duplication between the introductions of the sections dealing with taxa at different levels. This is a consequence of the taxonomic structure of the work. If a reader seeks information on a particular subject, it is sometimes necessary to look for it in the family introductions, the order introductions and the class introductions in order to get the full picture. Personally, I see this a s a strength rather than a fault. Especially as the material provided at the different taxonomic levels is usually written by different authors so that there is some variation in presentation and interpretation which adds to the flavour.

The illustrations are superb. They have been produced by many different artists. The fact that their standard and style is so consistently high is a measure of the meticulous attention to detail and the persuasiveness of the editors.

To me the most remarkable feature of this work is the achievement of the editors in prising the countless manuscripts, large and small, from the multitude of authors and collating them to produce these enormously complex volumes

with such a consistent standard throughout. To those of us who have contributed bits of the text, it is nothing short of miraculous to see this whole work together as an integrated whole. Frankly, many of us didn't believe it was possible when the project began The quality of the text is a credit to the standard malacology in this country but the creation of this volume is the work of the editors. I "dips my lid" to them. A fantastic effort.

In short, these two volumes represent a huge achievement by many people, but especially the editors, and a mileston in Australian malacology. The Australian Biological Resources Study must be thanked and congratulated for this extraordinarily valuable contribution to Australian natural science.

Barry Wilson

Instructions to Authors

General and theoretical papers relating to molluscs are welcome. Papers concerning specific geographical areas or new taxa should normally focus on the Indo-West Pacific region, as well as Australasia and the southern oceans. Papers received will be considered for publication at any time. Long papers and monographs may be published as special issues of *Molluscan Research.*

Papers are considered on the understanding they have not been published elsewhere and if accepted for publication in *Molluscan Research* will not be subsequently submitted elsewhere. All manuscripts must be submitted in English.

1. Papers submitted for publication shall be prepared following the format of the current issue of *Molluscan Research.* All papers will be peer reviewed by two referees before acceptance by the Editor, and upon acceptance all copyright will become the property of the Society.

2. Manuscripts, three copies of which should be submitted, should be double-spaced throughout, typewritten on one side of A4 paper, leaving top, bottom and margins of at least 3 cm. Right margins should not be justified. The first page of the manuscript should have the title, author's name and address, and a running head. The remainder of the manuscript should normally be arranged with the following components: abstract, materials and methods, results, discussion, literature cited, tables and figures.

Manuscripts of 6 manuscript pages or less can be presented in a Shorter Contributions format, with the headings eliminated.

3. Latin names of genera and species and Latin words and abbreviations (et al, e.g., etc.) should be in italics, but nothing else. Symbols and abbreviations should conform with those recommended in the Royal Society's General Notes on the Preparation of scientific Papers (London, Cambridge University Press). The first mention in the text of the scientific name of a species should be accompanied by the author and date. Metric and Celsius units must be used.

4. Text figures should be of good contrast, mounted, and of such size that they can be reduced satisfactorily to a maximum width of 14 cm. Black & white photographs for reproduction as halftone plates should be mounted, glossy prints showing good detail and moderate contrast; full plate size will be 22 by 14 cm. A size measurement should be included on the photograph; magnifications cannot be given in the figure heading. Colour photographs can be published at author's expense. Figures must be submitted in final form, ready for publication.

5. References should be listed alphabetically at the end of the paper in the form:

Habe, T. 1951. Donacidae and Myidae in Japan, in *'Illustrated catalogue of Japanese shells'*. Kuroda, T. (ed.), (Kyoto, Japan), pp. 71-78.

Hedley, C. 1913. Studies on Australian Mollusca, 9. *Proceedings of the Linnean Society of New South Wales* **38:** 258-339.

Keen, M. 1969. The Myidae. in: *'Treatise on invertebrate paleontology'*, Part N, Vol. 2 (of 3), pp. N691-692. Mollusca 6, Bivalvia. R.C. Moore (ed.), (Geological Society of America and University of Kansas Press: Lawrence).

Zinsmeister, W.J. 1984. Late Eocene bivalves (Mollusca) from the La Meseta Formation collected during the 1974-75 Joint Argentina-American Expedition to Seymour Island, Antarctic Peninsula. *Journal of Palaeontology* **58(6):** 1497-1527.

Titles of periodicals should not be abbreviated. In the text references should be cited with the year of publication, e.g. Shepherd and Cannon (1988).

6. Papers describing new species and subspecies will not be accepted for publication unless primary type material, and preferably paratypes, are deposited in a recognized public research or natural history museum and the museum registration numbers quoted. Type localities should be defined as accurately as possible. Descriptions must conform with the International Code of Zoological Nomenclature.

7. It is strongly recommended that the manuscript be prepared on a wordprocessor, following the *Molluscan Research* format, and that a floppy disk be returned along with the hard copy of the revised manuscript. This greatly expedites the preparation of proofs.

8. Page proofs will be sent to authors, who should return them with the least possible delay. Only the minimum of essential corrections should be made; changes to the manuscript made after acceptance will be charged to the author.

9. Reprints may be ordered only when page proofs are returned. Except for very long papers, reprints may be ordered only in lots of 25.

10. A payment per page is requested from authors able to meet publishing costs. These charges are negotiable, but are around $AUD50.00 per page. Colour plates are possible, but their total cost will be charged for.

MUSEUM
VICTORIA
4 JUN 1998

The Malacological Society of Australasia Ltd

The aim of the Society is to promote the study of Recent and fossil Mollusca and their associated invertebrates.

Membership in the Society is open to all persons. Members receive *Molluscan Research* and the quarterly *Australasian Shell News* and may attend meetings of the Society wherever held by branches throughout Australasia. Junior members, under 18 years, have the same privileges as members except the right to vote at meetings, hold office and receive *Molluscan Research*. Second members of a family (husband or wife) can become members for a reduced fee and have the same privileges except receipt of *Molluscan Research* and *Australasian Shell News*. Corporate membership is available to institutions, societies, etc. Affliate membership is available to non-commercial organisations with similar aims to MSA.

All inquiries regarding the Society and membership should be addressed to: Honorary Secretary, The Malacological Society of Australasia, c\- Dept. Malacology, Australian Museum, 6 College St, Sydney, New South Wales 2000, Australia.

Membership rates:

Ordinary members (within Australia)	AUD$	30.00
Ordinary members (outside Australia)		40.00
Extra family member		5.00
Junior members		5.00
Corporate members (Australia)		45.00
Corporate members (outside Australia)		50.00
Affiliate member		30.00

Molluscan Research

Molluscan Research, previously the *Journal of the Malacological Society of Australia*, is a semiannual publication for authoritative scientific papers dealing with Mollusca and related topics. General and theoretical papers relating to molluscs are welcome. Papers concerning specific geographical areas or new taxa should be restricted tot he Indo-West Pacific region, as well as Australasia and the southern oceans. Sets of previous volumes are available at various prices.

Subscription and sale enquiries for *Molluscan Research* should be addressed to the Honorary Secretary at the address above.

Editorial enquries regarding *Molluscan Research* should be addressed to:
Dr B.J.Smith, Queen Victoria Museum, Wellington St., Launceston, Tasmania 7250.
Email: brian@qvmag.tased.edu.au or bsmith@tassie.net.au

Website

For the most current information on the Malacological Society of Australasia, visit our website at:

http://www.austmus.gov.au/science/division/invert/mal/malsoc/malsoc1.htm

MOLLUSCAN RESEARCH

Volume 19, Number 1 19 May 1998

CONTENTS

K. Lamprell & J. Stanisic
Myidae from Australian waters (Mollusca, Bivalvia) 1

H. H. Dijkstra
Pectinoidea (Mollusca: Bivalvia: Pectinidae: Propeamussiidae) from Hansa Bay, Papua New Guinea 11

B. A. Marshall
A new monoplacophoran (Mollusca) from southern New Zealand 53

B. Scott
Anatomy and relationships of the papuinine land snail *Meliobba shafferyi* Iredale, 1940 (Pulmonata: Stylommatophora: Camaenidae) 59

B. A. Marshall
Food and feeding mode of Thysanodontinae (Mollusca: Gastropoda: Calliostomatidae) 69

B. A. Marshall
A review of the Recent Trochini of New Zealand (Mollusca: Gastropoda: Trochidae) 73

B. A. Marshall
The New Zealand Recent species of *Cantharidus* Montfort, 1810 and *Micrelenchus* Finlay, 1926 (Mollusca: Gastropoda: Trochidae) 107

Short Communication
D. L. Geiger
Note on the identity of *Haliotis clathrata* Lichtenstein, 1794 (not Reeve, 1846) 157

Book Review
B. Wilson
Mollusca: The Southern Synthesis, Parts A & B 160